Bulletin of the ATOMIC Scientists

A MAGAZINE FOR SCIENCE, PUBLIC AFFAIRS, AND EDUCATION

RECEIVED
JAN 18 1960
MIAMI UNIVERSITY
LIBRARY

JANUARY, 1950
VOLUME VI • NUMBER 1

50c

PHYSICS DEPARTMENT
Washington University

Featured in this Issue:

The Role of the National Laboratories in Atomic Energy Development

The Conquest of the United States by Germany

The State of Physics; or the Perils of Being Important

The City of Washington and an Atomic Bomb Attack

Can We Have International Control of Atomic Energy?

Science, Politics, and Citizenship

Progress in AEC Reactor Program

Common cause

"... fulfilling toward a United World the task that was fulfilled for the United States by the *Federalist Papers.*"—HAROLD C. UREY.

JANUARY—

Nuremberg . . . . . *Justice Robert H. Jackson*
A Re-examination of America's Conscience *Lewis Mumford*

FEBRUARY—

Mental Health and the World Community . . *Herman Finer*
Global Ideas Stir Capitol Hill
A Report on Congressional Hearings (with Meyer and Cranston, Owen Roberts and Culbertson)

AND FOLLOWING:

Representation in a World Legislature . . *Charles Merriam*
Decline of Liberty and of Mr. Laski . . *Hans Morgenthau*
The "Goal of Mankind" . . . . . *G. A. Borgese*
Reactions and Comments on the Chicago Plan *Hannelore Zander*
Food, Population, Development of Backward Areas
Contributions by *R. G. Tugwell, James Warburg, Henri Folmer, George H. Olmsted*

"The journal of one world"

What about Russia now that the bomb is no secret?
Can we "neutralize" Europe? What outlook for Asia?

THESE are the questions with which *Common Cause* deals—the vital, throbbing problems of our time. Each issue, now appearing in a smart new cover and larger size, brings you articles, essays, reviews, and information on the development of the world community.

READ contributions from some of the world's foremost thinkers, such men as: Claude Bourdet, Albert Camus, Alan Cranston, Harold Lasswell, Charles E. Merriam, Cord Meyer, Lewis Mumford, Ignazio Silone, Louis Sohn, Henry Usborne, Quincy Wright, beside members of the Committee as listed below.

One additional dollar brings you the Committee's
Preliminary Draft of a World Constitution.

Common Cause, published by the University of Chicago Press, is the monthly organ of the Committee To Frame a World Constitution at the University of Chicago. Members of the Committee are: Robert M. Hutchins, G. A. Borgese, Mortimer J. Adler, Stringfellow Barr, Albert Guérard, Harold A. Innis, Erich Kahler, Wilber G. Katz, Charles H. McIlwain, Robert Redfield, Rexford G. Tugwell

"... the most mature thinking on the subject so far."—LIFE.

The University of Chicago Press
Chicago 37, Illinois

Please send me *Common Cause:*
Regular: [ ] 1 year, $4.00
Student: [ ] 1 year, $3.00
Single issue: [ ] 35 cents

NAME .....
ADDRESS .....
CITY ..... STATE .....

NEW VOLUMES

in the

National Nuclear Energy Series

THE TRANSURANIUM ELEMENTS
Research Papers

Plutonium Project Record. Division IV. Volume 14B

Edited by GLENN T. SEABORG, University of California, JOSEPH J. KATZ and WINSTON M. MANNING, Argonne National Laboratory. 1778 pages, two parts (not sold separately) $15.00

This work consists of more than 150 original research papers dealing with the transuranium elements and cognate topics.

THE CHEMISTRY OF URANIUM
(Div. VIII. Vol.5)

THE CHEMISTRY OF URANIUM
Collected Papers (Div. VIII. Vol. 6)

Manhattan Project. Division VIII. Volumes 5 and 6 (available separately)

By JOSEPH J. KATZ, Chemistry Division, Argonne National Laboratory, and E. I. RABINOWITCH, University of Illinois. In preparation.

Scheduled for publication early in 1950, these volumes will comprise one of the most exhaustive critical treatises ever published on the chemistry of a single element.

IONIZATION CHAMBERS AND COUNTERS: EXPERIMENTAL TECHNIQUES

Los Alamos Project. Division V. Volume 2

By BRUNO ROSSI, Massachusetts Institute of Technology, and HANS H. STAUB, Stanford University. 243 pages, $2.25

Discusses the general physical principles underlying the operation of ionization chambers and contains a detailed discussion of a number of detectors developed by the authors.

ELECTRONICS: EXPERIMENTAL TECHNIQUES

Los Alamos Project. Division V. Volume 1

By W. C. ELMORE, Swarthmore College, and MATTHEW L. SANDS, Massachusetts Institute of Technology. 417 pages, $3.75

Describes the most useful and most successful electronic circuits for making nuclear and other physical measurements.

Send for copies on approval

McGRAW-HILL BOOK CO., Inc.

330 West 42nd Street New York 18, N.Y.

Bulletin of the Atomic Scientists

Vol. VI January, 1950 No. 1

In This Issue:

The State of Physics; or the Perils of Being Important
Samuel K. Allison 2

The Role of the National Laboratories in Atomic Energy Development
Henry D. Smyth 5

Can We Have International Control of Atomic Energy?
Leo Szilard 9

An Interim Plan for International Control of Atomic Energy
David F. Cavers 13

A Proposal for an Atomic Armistice
Cuthbert Daniel and John L. Balderston 17

United Nations Atomic Energy News
Francis W. Carpenter 18

The Conquest of the United States by Germany
Hans J. Morgenthau 21

Science, Politics, and Citizenship
Sir Robert Watson-Watt 27

The City of Washington and an Atomic Bomb Attack 29

Progress in AEC Reactor Program 31

"Constructive Uses of Atomic Energy"
Reviewed by Austin M. Brues, M.D. 32

Editor
Eugene Rabinowitch

Assistant Editor
Mrs. Alan Simpson

Publication Director: O. M. Forkert

BOARD OF DIRECTORS:

Kenneth S. Cole, T. H. Davies, Samuel Goudsmit, C. A. Hutchison, E. Rabinowitch, Edward A. Shils, John Simpson

BOARD OF SPONSORS:

J. Robert Oppenheimer, Chairman
Harold C. Urey, Vice-Chairman

H. A. Bethe, P. W. Bridgman, Detlev W. Bronk, A. H. Compton, E. U. Condon, F. Daniels, L. A. DuBridge, Albert Einstein, James Franck, S. A. Goudsmit, T. R. Hogness, F. W. Loomis, Philip M. Morse, H. J. Muller, Linus Pauling, G. B. Pegram, I. I. Rabi, Julian Schwinger, Cyril S. Smith, Leo Szilard, Edward Teller, V. F. Weisskopf, Sewall Wright, J. R. Zacharias

Drawings by Martyl and Ruth Vinson

Published monthly by the Educational Foundation for Nuclear Science, Inc., 956 E. 58th Street, Chicago 37. Phone: Midway 3-3056. Manuscripts should be sent in duplicate to Mrs. Alan Simpson at the above address.

Subscription and advertising service: All correspondence in regard to changes of address, new subscriptions, and advertising rates, should be sent to 53 W. Jackson Blvd., Chicago 4, Ill.

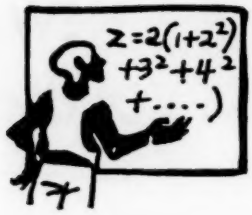
Subscription—$5.00 a year. Single copy—50 cents. Four weeks notice is required for change of address: both old and new addresses must be given.

Entered as second class matter at the Post Office at Chicago, Illinois, under the act of March 3, 1879.

Copyright, 1950, by the *Educational Foundation for Nuclear Science, Inc., Chicago 37, Illinois.*

387715

THE STATE OF PHYSICS; OR THE PERILS OF BEING IMPORTANT



Samuel K. Allison

In this article, Samuel K. Allison, wartime Director of the "Metallurgical Laboratory" of the Manhattan Project and present Director of the Institute of Nuclear Studies at the University of Chicago, views with some misgivings his profession's recent rise to fame.

THERE are many indications that the state of physics is good. The *Physical Review* is losing money, an excellent sign in itself. Its bi-monthly issues bulge with learned contributions to knowledge, and few, if any, of the Letters to the Editor stay within the 600-word limit prayerfully requested by the harassed editorial staff.

Though by no means an Elder Physicist, I can remember when all the sessions of the Washington meeting of our Society were held in a small lecture room at the Bureau of Standards. Even this one meeting was poorly attended; the happy physicists, not prodded by the goad of Government Contracts, mostly sat outside on the lawn and discussed mutual acquaintances. Nowadays a shuttle taxi service has to be provided to haul the panting members from auditorium to auditorium, and important papers have matinee and evening performances.

The only physicist widely known then was Dr. Einstein, whose theories were incomprehensible to his public, which, nevertheless, had correctly judged that something fundamental and new had been added. In these times any young man who can call himself a nuclear physicist is besieged with requests to speak before women's clubs on the world political situation, and the panel discussions on applied nuclear physics, if placed end to end, would stretch from Los Alamos to Bikini. Institutes for Nuclear Studies are springing up everywhere, each with a budget comparable to that of a pre-war university.

What great benefits has physics bestowed on mankind to merit all this prestige and assistance? We may cite the example of Michael Faraday, one of us, who contributed mightily to the fund of knowledge which made possible the well-nigh universal distribution of electric light and power, giving each of us a hundred servants to be summoned by the flip of a switch. Or the discovery of X-rays, by one of our profession, making diagnosis of internal injuries a matter of sight rather than touch. Or was it because of the work of our colleague Hertz, which led to the establishment of instantaneous wireless communication all over the earth? Unfortunately, we must face the facts. The principal motivating power behind the enormously increased support for physics in the last decade has been the realization that physics and physicists are important for waging war, and since waging war is important, physics is important. I know of many circumlocutions with which to gloss over this ugly statement; I am also aware that there are many who would challenge these words as a misrepresentation of the present state of affairs, yet I myself believe them to be essentially true, and am setting them forth as my opinion.

EFFORTS OF THE PHYSICIST DURING THE RECENT WAR

Let us look at the record. Almost too late in the 1930's, Britain became aware that all was not well in the best of all possible worlds. Incredible though it seemed, Hitler's Reich, founded on demonstrable falsehoods, built of palpable contradictions in logic, and advertised in public displays of mass hysteria, was not going to collapse of internal weakness. The preposterous statements of its leaders could not have stood up for an instant in open debate as understood in the House of Commons, therefore they carried no weight, and by all the precedents available to a civilized people, the perpetrators of these falsehoods should be powerless. But, strangely, this was not the case, and a triumphal march of Nazism over Europe seemed to be gathering momentum. Apparently, Britain would be faced with a foe in superior numbers and equipped with more industrial productive capacity than she could muster.

Ingenuity, inventiveness, and bold improvisation were needed to overcome these disadvantages. British physicists set aside their fundamental investigations and worked on the generation, reflection, and detection of short-wave electro-magnetic radiation, and on the reflection of compressional waves in sea water by boundaries in the medium. Military rockets and proximity fuses also claimed their attention. They, too, saw the alarming possibilities in the uncontrolled, fast fission, chain reactor of Uranium 235, and in the midst of the desperate 1940-41 period, carried on work on what must have seemed an almost hopelessly remote, last ditch possibility.

No one in his right mind, then or now, would state that these things should not have been done because they would associate physics and war in the popular mind, and, even worse, in the minds of the politicians. Physicists were caught in an inexorable procession of events which left them no choice; in fact, their duty was all too obvious.

The wave of response of physicists in America to the emergency was retarded in phase, but its amplitude, greatly augmented by the influx of scientists from the dictatorships, proved to be even greater than that abroad. I would like to single out one name, that of our late member, Professor Richard C. Tolman. Of all the scientists whose war record is well known to me, I believe he saw farthest and sacrificed most. In that awful spring of 1940, when

each day brought sickening news, Tolman gave up his quiet study of statistical mechanics, rented his house, and moved to the bedlam that was Washington, where he assisted in organizing the National Defense Research Committee.

Some men rather like bedlam; the constant excitement, the hasty decisions, and the sense of power arising from the appropriation of huge sums pleases them. Tolman was of a temperament which loathed all this. Yet through the boiling summers, and throughout the year, for year after year, he attended conferences, evaluated projects, placated prima donnas, and encouraged the disconsolate. Tired and spent each evening, he slept to gather strength for another day. When he returned to his academic life after the war, he deserved many more years of scholarly life than were granted him.

The war effort, initiated by a few men like Tolman, spread through the ranks of our Physical Society until every one of us was affected. The overwhelming majority were actively engaged in classified war research and development projects, and those who for various reasons could not engage in such projects carried the load of instruction in streamlined courses for military trainees.

The projects in which the physicists played a prominent role were astonishingly successful. The primitive radar equipment developed in Britain enabled a pitifully small number of Spitfire pilots to win the Battle of Britain, and the further joint development of radar dramatically swept the Atlantic clear of enemy submarines in a matter of weeks.

Hitler made the mistake of assuming, until too late, that he had won the war by means of what we might now call "classical" weapons. In the latter stages of the war, German scientists developed the formidable V-1 and V-2 missiles, and resumed their efforts on nuclear energy, the latter without signal success. The final climax, after the defeat of Germany, came with the destruction of an entire city by the uncontrolled release of nuclear energy, which awed our enemy into an early surrender, and terrified ourselves with a fear that is deepening as time goes on.

PRESTIGE OF PHYSICS AND PHYSICISTS SUDDENLY GREATLY ENHANCED

The bewildered public was told that these things had been done by physicists, and, in particular, in the spectacular case of the atomic bomb, by nuclear physicists. The great industrial companies, without whose organizing ability and technological know-how the nuclear physicists would have been helpless, avoided the spotlight of publicity as much as possible. They remembered that those who had supplied ammunition to our troops in World War I were, after a sudden reversal of public opinion, excoriated as "merchants of death," and accused of fomenting wars in order to market their products. It is my feeling that the physicists might have done well to use a bit of this caution.

Suddenly physicists were exhibited as lions at Washington tea-parties, were invited to conventions of social scientists, where their opinions on society were respectfully listened to by life-long experts in the field, attended conventions of religious orders and discoursed on theology, were asked to endorse plans for world government, and to give simplified lectures on the nucleus to Congressional committees. No wonder heads were turned, and physicists rapidly became accustomed to, and accepted as normal, a standard of living and traveling which was only related to their immediate past by a vertical discontinuity.

PHYSICS AND THE MILITARY ESTABLISHMENT

The extent to which physics had become important was not fully brought home to me until I was shocked by the news of the destruction of the cyclotron in Tokyo. Surely no physicist could have instigated this senseless act, or approved of the order which was issued to initiate it. The important and dangerous nature of physics was so obvious to some military officer that the cyclotron was cut to pieces in the same way that one would spike the enemy's guns or blow up his fortifications.

I consider myself a patriotic citizen of the United States. When our country does something which seems to me to be generous and wise, such as the distribution of radioisotopes to qualified scientists everywhere, I feel a glow of pride. When we behave in a way which seems to me unworthy, I feel shame. The Tokyo incident seemed shameful to me. Who would now believe in our pretensions of spreading enlightenment, scientific knowledge, and technical progress over the world? To disarm a surrendered enemy, occupy his country and attempt to lay the foundations for a new and peace-loving government is a sensible procedure; this act, however, could only have been motivated by petty malicious revenge, to which a civilized adult should not stoop.

In the same connection, the following regulations, affecting the conduct of research in physics in occupied Germany, have come to my attention. To the officials who drew up this document, physics is very important.

Let us look at Law No. 23, issued by the Military Government, Germany, to be effective September 12, 1949, in the United States Area of Control. The Law is entitled "Control of Scientific Research," and consists of thirteen articles. A "Regulation No. 1," accompanying the law, contains eight articles.

Article II of the law prohibits fundamental scientific research wholly or primarily of a military nature.

A conscientious military governor, attempting to enforce this article, would have some very difficult decisions to make, and I doubt that an advisory board of scientists could help him very much.

Article III prohibits applied scientific research on any matter wholly or primarily of a military nature, or any of the matters specified in Schedule A. Turning to Schedule A, we find Nuclear Physics as Item 1, followed by other categories which the authors of the legislation considered to be clearly military in nature. Other articles specify how "any natural or juristic person or group of persons, engaged, even incidentally, in scientific research" shall proceed to obtain permission for such work, and describe the numerous reports which must be submitted.

Article VIII states that "all data, reports, notifications, files, and any documents concerning the implementation of this law shall be kept secret by all those who have knowledge of them and may only be used for control purposes," and Article IX specifies punishment by imprisonment up to life or by a fine not exceeding RM 500,000 or both, for persons conducting research illegally.

These regulations were agreed to by our representatives in Europe, and if, as we boast, our Government is responsible to our people, they have our approval if we do not protest. I had thought, however, that the futility of edicts of this kind had been conclusively demonstrated during the Renaissance period; it is a shock to find them in modern dress. Furthermore, I consider the statement that Hitler, if he had conquered Europe, would have made much worse regulations, as having no bearing on the case. In matters such as this, I consider that absolute standards of conduct must be applied, and by such standards, I judge that the

least one can say about these regulations is that they are unenlightened.

SUPPORT OF PHYSICS IN THE UNITED STATES

The state of physics here in the United States is the product of many factors, some of which I will now mention. In the first place, the kind of experimental physics that most of us agree is most interesting to carry out, and in which we all confidently expect fundamental and revolutionary discoveries, is a very expensive kind of physics. I refer, of course, to the study of the effects of particles moving with kinetic energies comparable to and greater than their rest masses. At the same time that these researches are in the spotlight of interest, the income from the capital available to universities has dwindled, and the federal income tax structure makes difficult the amassing of the large personal fortunes which have been the principal source of donations. Clearly, such enterprises cannot be carried out without the allocation of public funds. Such funds are now available, thanks to the new importance of physics, and we see some 75 per cent of the reported researches acknowledging the aid of the Joint Program of the Office of Naval Research and the Atomic Energy Commission. An encouragingly large fraction of these researches are unclassified, as free and as open as before the war. Some, however, are secret, and carried out under guards with loaded guns. This matter of secrecy I consider very serious, and as a taxpayer I question the advisability of supporting secret research with my tax money.

DANGER THAT SECRECY RESTRICTIONS MAY SPREAD INTO BASIC RESEARCH

One may discuss the evils of secrecy under the following two headings:

1. Secrecy suppresses basic physical knowledge concerning the universe which should be used to stimulate physical thinking everywhere.

2. The existence of an inner core of secret facts vitiates whole areas of scientific inquiry and technological development extending far from the actually classified data. No one can remember from day to day just what is classified, and to be safe, avoids discussing whole fields of research and technology.

At the present time it is probable that the harm done by the second of these two categories is worse than that done by the first. Concerning the first, there seems to be an unbridgeable gulf between the attitude of the scientist and that of many lawyers, politicians, and military officers. The hopelessness of the chasm was impressed on me during the war period, when the situation was patiently explained to us in words of one syllable. When workers in an army ordnance plant make a howitzer, they are well paid for their work. The howitzer, however, does not belong to them. It is delivered, well-crated, all parts checked and double-checked, to the War Department, which uses it or not, as it sees fit. In the same way, the physicist is paid to obtain information which the Government wants. This information, obtained by experimentation or calculation, does not belong to him. He writes it up carefully and delivers it to the agency which pays his salary, and this ends the matter. This discourse had its intended effect. It reduced me to a state of speechlessness, and no reply was formulated.

Fortunately, the persons in charge of disbursements of government funds for research in physics do not operate on this highly simplified procedure. As far as an outsider like myself can judge, an earnest effort is continually being made in the Atomic Energy Commission to declassify basic researches, within the directives given by Congress.

One difficulty is to find a definition of basic research, but I regard this as a minor one. I believe that a good working definition of a basic research report is one which would be accepted for publication in the *Physical Review* or, for instance, the *Journal of the American Chemical Society*. The Boards of Editors of such journals are continually distinguishing between basic research and its technological application.

In spite of the efforts within the Atomic Energy Commission, certain information concerning the details of the fission process, and eminently suitable for publication in the *Physical Review*, remains secret, and, therefore, sterile. Who can say that these facts, if known to another Yukawa or another Dirac, might not prove the missing link in the formulation of a successful theory of nuclear forces?

In a recent radio round table, one of my colleagues advocated the removal of secrecy from many of the activities of the Atomic Energy Commission. An ex-military officer present concisely summarized his objections as follows: "This is childish. Why help the Russians?" This argument could have been used to prevent the publication of the structure of penicillin, or of the discovery of the physiological properties of cortisone. Who can guarantee that these items of information may not help the Russians invent more horrible forms of bacteriological warfare? How much more probable it is that the news of these discoveries will stimulate ideas everywhere, which, radiated back to the original workers, will hasten the elucidation of many of the poorly understood properties of these drugs.

The requirements of secrecy, not to be confused with security except in some military minds, prevent any open and effective discussion of the feasibility of breeding, which will probably be vital to the large-scale peaceful application of nuclear energy. I know from experience here in Chicago, with the Commonwealth Edison Company, that engineers are eager to learn about, and to discuss, such problems.

FBI CLEARANCE FOR AEC FELLOWSHIPS

A further discouraging development has been the restriction put on the Atomic Energy Commission fellowships, making clearance, as a result of an expensive character-and-associations study by the Federal Bureau of Investigation, a prerequisite. The attitude of the politicians seems to be that the AEC fellowships are for the purpose of training young men to work in the laboratories of the Commission. This stands in unfavorable contrast to the attitude of many industrial donors of fellowships, which are given to develop science and train young men, with no strings attached.

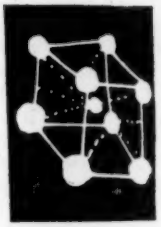
I believe that universities are badly in need of fellowships for promising young scientists, and that we must educate our legislators to the fact that scientific ability is not uniquely associated with a certain set of political opinions. It is the nature of youth to make a break with established conventions, to want to see for itself, to want new experiences. This is extremely healthy for society, even though temporarily it may be painful for parents. A twenty-year-old college student, who is learning standard, unclassified physics as a recipient of an AEC fellowship will be seen reading *Das Kapital* at the peril of his livelihood and his entire future. This is exactly the persecution for "dangerous thoughts" which we found so amusing and foreign to us in pre-war Japan.

In the hearings of a Congressional Committee devoted to this subject, one of our elected representatives remarked

(Continued on page 26)

THE ROLE OF THE NATIONAL LABORATORIES IN ATOMIC ENERGY DEVELOPMENT

Henry D. Smyth



Henry DeWolf Smyth, formerly Professor of Physics at Princeton University and the author of the "Smyth Report," is a member of the United States Atomic Energy Commission. He was chosen by President Truman in April, 1949, to fill the vacancy on the Commission created by the resignation of Robert F. Bacher.

IN THE period between the two World Wars science flourished in this country to a greater degree than ever before. Although we continued to depend heavily on Europe, particularly in such fields as theoretical physics, the number of well-trained, able men in this country multiplied greatly and our laboratories became well equipped and well organized. The value of research began to be recognized although not completely understood.

REASONS FOR RESEARCH

There are, I believe, two major reasons why scientific research contributes to the vigor and welfare of a people. The first reason is that it enlarges and enriches men's minds. It gives them a better balanced picture of the universe in which they live and of their place in it. It stimulates their imaginations; it strengthens their intellectual powers; it gives them confidence and tools with which to attack collectively some of the problems which confront them.

The second reason for pursuing scientific research is the contribution that it makes to our material welfare. This is very readily demonstrated and certainly needs no amplification. Though the actual material results of research are the major justification for the existence of many of our great scientific enterprises, and particularly those of the Atomic Energy Commission, I think it has become clear, even to the layman, that we cannot separate one kind of research from the other. Few would be so bold as to pin a "useless" label on any effort to find out more concerning the fundamental laws of nature. Similarly, research undertaken for the most mundane utilitarian purpose may be as stimulating and productive of basic information as the most erudite effort in the field of so-called pure science.

Few of our great laboratories, and I hope none of those supported by the Atomic Energy Commission, are so narrowly dedicated to the immediate, practical results as to ignore completely basic scientific research. By the same token I hope none of the AEC laboratory groups will ever look down on applied work. With this kind of intellectual snobbery I have no sympathy. There is nothing inherently evil or degrading about being useful.

Before discussing different kinds of research organizations, may I say that in the rest of my paper I will refer to research aimed primarily at the fundamental laws of nature as basic research and to research aimed primarily at material results as applied research.

RESEARCH ORGANIZATIONS

Before World War II there were four kinds of organizations pursuing with varying emphasis either or both of these aims. These were, of course, first, university laboratories; second, industrial laboratories; third, independent research institutions; and fourth, government laboratories. All these types of institutions still exist. One can say roughly that the university laboratories and the privately endowed research institutes are primarily concerned with basic research, while the government laboratories and industrial laboratories are more concerned with applied work. However, one must remember that the functions of all of them overlap both fields. In the case of the universities, there is a third function, that of teaching, so that even university departments doing no applied work have more than one objective.

ADVANTAGE OF MULTIPLE FUNCTIONS

When I first started on a scientific career, I was convinced that the ideal place to do scientific research was in an institute devoted solely to that end. I have rather sadly come to the conclusion that this is not so. Since I am addressing a scientific audience, I will at once concede that scientific people are very exceptional and that they are set apart from ordinary mortals by greater imagination, intellectual power, and longing for pure truth. Unfortunately, I find that even in this highly selected group there are very few so able and imaginative that they can think great thoughts all of the time. For such few, positions that carry no responsibility other than to do work of Nobel-Prize caliber may be desirable, but for most of us I believe a certain amount of bread-and-butter work, whether it be teaching or programmatic research of an applied character, is actually beneficial.

I believe that most of us can do better basic research in an organization that is not devoted exclusively to basic research. In the scientific departments of the universities, this other objective is teaching, which has the additional advantage of bringing men constantly in contact with fresh, young minds. In government and industrial laboratories, I believe the contact with specific applied problems and

with men who have to get the answers to such problems provides a similar stimulus.

To summarize, I believe that science flourishes in terms of three functions —basic research, applied research, and teaching—and that the most fruitful institutions are those which are trying to discharge at least two of these functions. I have outlined this general philosophy because it is fundamental in the understanding of the place National Laboratories should have in our general scheme of education and research.

INCREASED COST OF RESEARCH

There is one other factor that I should mention before becoming more specifically concerned with the AEC and its laboratories. It is the influence of the greatly increased cost of research on the relative importance of government and industrial laboratories compared to those in universities and privately endowed institutes. The importance of major equipment of very great cost has grown steadily for the past twenty years, particularly in the field of experimental nuclear physics.

It is easy to overemphasize the importance of the equipment compared to brains—and in this country we have a tendency to do just that—nevertheless, apparatus such as reactors, Van de Graaffs, and cyclotrons is important, and I think research in this country, at least in physics, might have taken a very different course since the war had not nuclear physics demonstrated its value in military affairs so that large expenditures of government money for elaborate equipment can be justified.

AEC OBJECTIVES

Now, I am ready to discuss why the National Laboratories are supported by the Atomic Energy Commission. The first is to make more and better weapons. The second is to develop possible peacetime uses of atomic energy; and the third is to develop such scientific strength in the country as is needed in the long run to support the other two. Success in each of these three objectives requires activity in terms of all three of the functions I have cited as necessary for a flourishing science, namely, basic research, applied research, and teaching. Let me amplify this point.

Take first the production of more and better weapons. Here teaching would seem to be of little importance. Perhaps so. Yet anyone who has been at Sandia and Los Alamos knows that the need for it exists. As to research, most of it is necessarily applied in character, yet it would be folly to forget that the atomic bomb of 1945 was the direct result of basic research carried on in the 1930's with no thought of any practical application.

Evidently, when we know as little as we do of nuclear forces and even of the experimental values of certain nuclear cross-sections, we must study these basic problems. For nuclear explosives, we need more knowledge of nuclear laws and constants. Similarly, for the other components of the weapons and for the many associated processes of production, we need more basic knowledge of the chemical and physical properties of materials. Surely the weapons of ten years from now will depend on the research of today.

The second objective of the Atomic Energy Commission, peacetime uses of atomic energy, likewise involves applied research, basic research, and teaching. I will only say here that the relative emphasis on function does not appear to shift very much compared to that of the weapons program. In subject matter it certainly does shift with greater weight going to medicine and biology compared to the engineering and physical science.

Finally, to achieve the third objective of the Atomic Energy Commission—building up the scientific strength of the country—we still need all three of our functions, basic research, applied research, and teaching, but there certainly must be an increased emphasis on teaching; and therefore, the universities must play a larger part in achieving this objective than in the other two. Yet the Atomic Energy Commission plays a direct role here, too, and has responsibilities that cannot be discharged by merely handing out money to various impoverished educational institutions.

REASONS FOR THE NATIONAL LABORATORIES

I think the National Laboratories help toward all three of the objectives of the Atomic Energy Commission, as do other laboratories throughout the nation. There are good reasons why the National Laboratories are needed and why their functions cannot be discharged by already existing research or development organizations. One of these, of course, is secrecy. Another reason is our wartime experience, which showed the advantage of gathering together a large group of men from the various divisions of science to work in close cooperation on problems involving a variety of fields and techniques.

Such a group needs to be larger and more varied than can healthily be built up in any single university. Furthermore, it must be ready to take orders. There are times when the AEC must have answers to perfectly definite practical questions on which the safety of the country depends. Sometimes getting the answers to such questions involves long arduous programmatic work that may be both dull and dangerous. I do not see how we can expect such work to be done properly or effectively in university or industrial laboratories.

Finally the nature and cost of the special equipment required for much of both the basic and applied work of interest to the AEC is such as to dictate its location in government-supported laboratories. It is fortunate that we have found large groups effective in research because one could hardly justify building a 20-million-dollar reactor, with associated hot laboratories and medical supervision, on a university campus for the use of a few professors and their students. The financial quanta involved in this enterprise are way beyond the absorption limits of university budgets or, indeed, of those of single industrial corporations.

To summarize, the AEC needs the National Laboratories because it needs secrecy and big groups of scientists who will take orders, and big equipment.

HISTORICAL BACKGROUND OF THE NATIONAL LABORATORIES

Before I attempt to differentiate in the functions of the various National Laboratories, I will remind you how they originated, and in this discussion I will include not only Oak Ridge, Argonne, and Brookhaven, but also Berkeley and Los Alamos. Of this group of five great laboratories, Berkeley is the only one which had a prewar history. It was well established in the thirties as the largest single university installation for nuclear physics. During the war, it was diverted to isotope separation after the construction of the 184-inch cyclotron had begun and before it was finished. After the war, it seemed natural to continue it, first out of Manhattan District funds and then with funds from the Atomic Energy Commission, as a research center for nuclear physics and radio-chemistry. Because of its history it naturally continues as sort of a cross between an enlarged university department and a localized Atomic Energy Commis-

sion installation. I would say that essentially its support is a recognition of the existence of an able group of scientific men with interests and equipment closely allied to the central interests of the Atomic Energy Commission and, therefore, well worth support by Commission funds. As long as the situation continues as healthy as it is there, I think that Atomic Energy Commission control should be relatively weak.

At the other extreme is Los Alamos which was set up during the war for a specific purpose and still exists for a specific purpose. I do not mean that no basic research should be done at Los Alamos. As I have explained earlier a certain amount of basic research is entirely appropriate there. Yet most of the work is not only applied but is programmatic. In a sense, I think the people running Los Alamos have the simplest problem of any of the Atomic Energy Commission laboratories, because they have the clearest and most immediate objective.

The Argonne Laboratory in Chicago also grew out of a war laboratory which had been set up there for a specific purpose: first, to achieve a chain reaction and then to design the Hanford Plant for the production of plutonium. It was the first reacor laboratory, but such was the variety of the problems it had to study that only a small group of the men there were directly concerned with reactors. The reconstruction of Argonne on a new site, and the assignment of the principal responsibility for reactor development seems to me to have caused more of a discontinuity in the purposes and functions of that laboratory than, say, at Berkeley or Los Alamos.

The laboratory at Oak Ridge started as a service and research laboratory in connection with the first chain reacting pile. Its original functions came directly out of that activity, and it was here that the first considerable amount of plutonium was produced. Many of those functions have now lapsed for one reason or another, yet such is the vitality of the group that they have established themselves as an essential part of the Atomic Energy Commission program. It is harder to define exactly what they are supposed to do than it is for the other three laboratories that I have mentioned, but in going around the laboratory last Saturday I saw nothing that seemed inappropriate for an AEC laboratory and much that was extremely pertinent. This laboratory always has been partly a production center and it still has the function of isotope manufacture and of making other materials essential to the work of the Commission. Also, it still has a number of testing functions for which it is well equipped, and in doing which it performs an extremely valuable service. Biological research has built up here largely since the war until it is very effective. Perhaps the fairest thing to say is that Oak Ridge National Laboratory does a lot of miscellaneous jobs on development and research which are essential to the Commission and which do not have to fit neatly into an organization chart or research program to justify their continuance.

Finally, Brookhaven Laboratory is the only National Laboratory founded since the war and naturally has a very different origin from the others. It really owes its existence to the recognition on the part of a number of people in the Northeast that there were certain facilities which no one university could afford to construct but which were badly needed if the research departments of these universities were to continue to be first rate. This, of course, is no justification for spending a lot of government money at Brookhaven. The other side of the picture was the recognition, first by the Manhattan District and later by the Atomic Energy Commission, that there was a large group of able scientific people in the northeastern area who in the long run could contribute greatly to the basic scientific problems facing the Atomic Energy Commission and were, therefore, worth supporting. Because of its origin, and because the hope is that the staff at Brookhaven will be largely a rotating staff, emphasis there should be principally on basic research. It is still uncertain just how it will work out, but I would say that the bread-and-butter routine work of the Brookhaven group is rather teaching at the various universities in the area than doing programmatic work at Brookhaven, although I expect that as facilities are built up there some programmatic work will be done and the people there will be glad to have it. As far as teaching is concerned, I have never felt that that was going to be very important at Brookhaven, although I know others take a different view. At Oak Ridge, on the other hand, the teaching, in a general sense at least, should be very valuable because of the relative weakness of the scientific departments of universities in this region.

There is one aspect of the teaching function of all the National Laboratories that arises directly from our present policy of secrecy. There are special courses and special meetings devoted to classified material. These are certainly most appropriately carried out in the National Laboratories, and I think Oak Ridge was the first to recognize the importance of this kind of work and has carried more than its fair share of this responsibility. I do not want to cite these activities, however valuable, as reasons for the existence of the National Laboratories because I do not want to imply that our present secrecy policy will never be modified.

OPERATION OF THE NATIONAL LABORATORIES

I think it is inherent in research that there is no simple answer to the question, "Who runs the National Laboratories?" I might also say in passing that the existence of friction, or at least vigorous disagreement on this question between various people or groups in the laboratories and the groups in Washington does not worry me at all. I should be much more worried if everybody appeared to be perfectly happy because I would then feel that everybody was slumbering peacefully in an autumnal haze of mediocrity. Obviously, it is the business of the Atomic Energy Commission staff in Washington to see the picture as a whole and to ask certain laboratories to do certain things. These things may range from asking a specific answer to a technological problem to be found within a given time to approving a basic research project suggested by someone in the laboratory itself. There will probably always be a tendency for those who pay the bills to ask for too strict an accounting. If that happens, I think it is the business of the laboratory director to remind the Washington group or its representatives that research cannot be run this way. I am sure there will also be a tendency for those in the laboratory to plan a program of research with a cheerful disregard of cost. It will then be the business of the Atomic Energy Commission's representatives to remind the laboratory director that we do not have an infinite supply of cash.

If I am pressed for a specific answer to the question of who runs the laboratories, I would say that the five members of the Atomic Energy Commission run them.

I have been asked: How about the division between project work and non-project work? Should the National Laboratories be capable of carrying out large, complete applied projects?

My answer to the second part of this question is yes. Certainly, some

of the National Laboratories should be so equipped. I think Oak Ridge is so equipped and staffed, and I'm glad of it. As to the division between project and non-project work, I'll not try to give percentages. I believe both should go on simultaneously and that, in spite of apparent conflict, each will profit by the presence of the other.

I have already tried to give a general answer to the question of who runs the National Laboratories, but I think I would like to return briefly to the questions in terms of actual organization. The present arrangement whereby the Commission in Washington delegates a large part of its authority to offices in the field has a great many advantages. It seems to me, however, that it does raise some difficulties in connection with the laboratories. These difficulties are not fundamental. More maturity in the whole arrangement will eliminate them.

It is evident that the regional offices have a great variety of responsibilities, including housing, budget, research program, etc. They cannot be expected to see the picture as a whole, and I believe it is particularly difficult for them to make judgments about research programs since these are the most vague and long-range of the activities of the Commission. I am very pleased with the new arrangement that has been set up whereby certain of the people in Washington have direct responsibility for research in certain of the National Laboratories. Of course, it must remain true that budgeting and control of expenditures go through the local offices. It is, therefore, in one sense a parallel organization set up which might cause difficulties. I think these will be readily overcome by frequent conferences between the Washington research people, the directors of the laboratory, and the men in the local offices who are primarily charged with research activities. Such consultations I hope will be frequent, and particularly, I would hope that research programs and budgets would be generally agreed upon by all three groups before being formally transmitted by the laboratory director through the contractor to the local office and then to the Washington office.

FUTURE OF THE NATIONAL LABORATORIES

I think we should frankly recognize that the whole scheme of National Laboratories is a novel one, just as the whole AEC enterprise is a novel one in this country. There have, of course, been government laboratories in the past but none on such a scale as these. There are certain dangers that I think can be spelled out even now. One is the danger of getting overlarge. I have cited as one of the reasons for the existence of the National Laboratories our experience during the war with the effectiveness of large groups. The situation then was different; there was a sense of urgency and a sense of novelty which helped these groups to work harmoniously and effectively. Even so, there are those who argue that the best basic research is done by a few people working in isolation.

Were it not for the very expensive equipment needed now for both basic and applied research, some would argue that the AEC might do better to put its money in university research rather than in maintaining these big laboratories. I have tried to explain why I do not think this is so, but it could turn out that a mistake has been made. The National Laboratories must be alert to fight red tape, even red tape imposed on them by the Commission in Washington, to bring in new blood, and to avoid the idea that a problem is necessarily best solved by spending several million dollars on a new facility and asking the personnel officer to hire ten men who have Ph.D.'s.

It is also possible that the National Laboratories may succeed too well. If their facilities and their salaries and their general atmosphere become as good as I hope they will, there may be a drift of the best men in science to them to such an extent that the university laboratories will be seriously weakened. I know that at present the directors do not feel this way. They are very humanly more conscious of the good men that they want who prefer universities than they are of the good men that they get away from the universities. I'm not at all sure that it will continue so, but I think it would be very unfortunate for the Commission activities and for the country in the long run if the balance should shift too much in the other direction.

PRESENT SITUATION IN THE AEC

In closing, I would like to review the present situation in the whole atomic energy enterprise as it appears to one who has just survived a summer in Washington and a Congressional investigation. It was made clear in this investigation that the inevitable let down and uncertainty at the end of the war had brought the activities of the Manhattan District into a sad state, and that the AEC, when it took over nearly three years ago, was faced with a tremendous task. The investigation, I believe, showed that the Commission had done an excellent job on the whole in reorganizing and in getting its work started on a long-range peacetime basis. From the organizational point of view, we should now be emerging from that period. There remains a good deal of construction to do at various places, but the plans are well set for it, and there is reason to think that they will go forward without serious interruption. The reactor program is beginning to move. The production of fissionable materials and of weapons is well in hand; the distribution of isotopes is a thriving business; and the research activities in the Commission laboratories and in laboratories supported or stimulated by the Commission elsewhere are flourishing. This is all very fine, and as of early September, with the investigation over, there was certainly a tendency in the Commission to relax.

Now we are confronted with a new situation. We can say truthfully that we all expected the Russians would make a bomb and the fact that they apparently have made one is no great surprise. I would even say that the time they have required for producing their first atomic explosion was within the limits of error of our best guesses. Nevertheless, it is one thing to anticipate an event and plan in terms of it. It is quite another thing to know definitely that it has occurred. We may not want to change our plans, but we would certainly be remiss if we did not reconsider them in terms of President Truman's announcement of September 23rd, and we must now feel a sense of urgency in all parts of our program. We must not be stampeded into dropping long-range plans, but we should no longer expect to test and retest and reconsider and get outside committees to advise us on every project we undertake.

We must depend more than ever on the experience and confidence of the men in the National Laboratories. Undoubtedly, we will all make mistakes. When they are found, we must be more concerned with repairing them than with deploring them. I feel that everyone in the National Laboratories and everywhere else in the Commission's activities will cooperate in this new situation, and I know that in consequence we will do our part in making this country as strong as possible. From the bottom of my heart, I hope that this strength will never have to be used for destruction.

An address given at the General Information Meeting Banquet, Oak Ridge, October 25, 1949.

CAN WE HAVE INTERNATIONAL CONTROL OF ATOMIC ENERGY?

Leo Szilard

Professor of Biophysics

University of Chicago

THE policy of the United States to strive for an agreement eliminating atomic bombs from national armaments originated in 1945 with President Truman. There is no evidence that he has ever given up the hope that this policy may yet be put into effect.

Today the American people seem to sense the hardships and dangers that we face if the atomic arms race begins in earnest. Thus, while our representatives at Lake Success keep on playing their gramophone records whenever the subject of atomic energy comes up, the public has begun to grope for some solution that might lead to a satisfactory agreement.

In magazine articles and in the daily press, questions are being asked whether we couldn't reach agreement on atomic control by dropping the demand for the elimination of the veto, by defining the stages in a manner that will satisfy Russia, or by proposing some form of control other than that of international management which we have hitherto tried to push. It is being suggested that perhaps we should couple the discussion on atomic energy with discussions aimed at general disarmament, as the Russians had always wanted us to do. Finally, it is being proposed that we conclude a convention which would pledge the nations, in case of war, to refrain from using atomic bombs and perhaps even renounce all strategic bombing.

There seems to be a general feeling that somehow we ought to try to stop the arms race right now, that the crying need of the hour is a stand-still agreement on armaments which will give us a breathing spell.

Do these questions, suggestions, or proposals point a way to the solution of the problem with which we are faced? I do not believe so. I rather believe that we shall not be able to make any progress unless we first review our over-all foreign policy. I believe that the crying need of the hour is a stand-still agreement not on armaments, but rather on Germany. For what Russia and the United States may do in Germany in the near future might create a situation which cannot be remedied later. It might deprive Russia and the United States of freedom of action as far as disarmament and peace are concerned.

You probably know the story of the drunk who was poking under a street lamp in Trafalgar Square in London when a policeman tapped him on the shoulder and asked him what he was doing there. "I am looking for my house key," said the drunk. "Did you lose it here?" asked the policeman. "No," said the drunk, "I lost it in Soho." "If you lost it in Soho," said the policeman, "why, then, do you look for it here under this lamp?" "Well," said the drunk, "There is light here, and in Soho it is dark."

My point is, that the key to the control of atomic bombs does not lie in the narrow area of atomic energy on which the spotlights of public discussion are focused, but rather in the dark fields of our over-all foreign policy which are only scantily illuminated by occasional comments.

THE REAL ISSUE

What is the real issue between Russia and the United States? What is the main goal of our present foreign policy in Europe?

In 1939 Great Britain decided to go to war with Germany rather than to accept a situation in which one country would militarily dominate the continent of Europe. The war was won, but when it ended, one country, Russia, had a dominating military position on the continent of Europe. Soon after the war ended, Belgium, France, and Holland were militarily at the mercy of Russia in the sense that Russian land armies could have overrun these countries.

We would rather not leave Western Europe for long at the mercy of Russia if we can help it. We have hoped to strengthen and arm Western Europe to the point where it could successfully resist a Russian attack until an American expeditionary force could come to its assistance.

Because we have been thinking in these terms for the last few years, we were not willing to consider an agreement providing for general disarmament, which Russia appeared to desire. For general disarmament—so we argued—could not touch Russia's main source of military strength—her large manpower which enables her at short notice to put into the field huge land armies. Thus general disarmament would perpetuate a situation in which France, Belgium, and Holland are militarily at the mercy of Russia.

By integrating Western Germany politically and economically with the rest of Western Europe, we have hoped to strengthen Western Europe to the point where it would be capable of holding an attack by the Russian armed forces.

IS OUR GOAL ATTAINABLE?

The first question I am going to raise is whether this goal of our foreign policy is still attainable now that Russia will soon have an appreciable quantity of bombs.

Because of the importance which a few large cities play in her structure, Western Europe is exceedingly vulnerable to atomic bombs. When Russia will be in a position to deliver such bombs in quantity anywhere in Europe, and when there will be nothing that America can do to protect European cities from destruction at the outbreak of the war, then the Atlantic Pact will have lost much of its value to Europe.

The rearmament of Western Germany would enormously strengthen the military power of Western Europe, and it will therefore undoubtedly be advocated on the ground that it is a calculated risk. But I believe it would be more correct to say that it is an incalculable risk.

Perhaps Western Germany, rearmed,

Address given December 10, 1949 to the Rochester Institute of International Affairs, Rochester, New York.

would fight on our side. Perhaps even without rearming Western Germany, we could make Western Europe strong enough militarily to offer us a reliable base of military operations; perhaps in spite of bombs the French would hold out; perhaps there would be no Dunkirk. Maybe we could count on France as our military base in case of war and thus avoid the need to plan on establishing bridgeheads on hostile shores in Europe.

On questions of this sort, it is difficult to speak with any degree of assurance. There may be doubt either way, and I am content here, having raised the question, to leave it unanswered.

A CHOICE MUST BE MADE

But now we have to answer another question. Can we continue to pursue our foreign policy aimed at preventing Russia from dominating the continent of Europe, and can we at the same time, obtain an agreement with Russia on eliminating atomic bombs from national armaments?

To this question my answer is a clear and unequivocal NO.

As long as we hold on to our present political goal in Europe, Russia will hardly be willing to deprive herself of the one weapon which, in the long run, might induce Western Europe to abandon her alliance with the United States. And even if this consideration did not weigh heavily with Russia as it probably does, there is still this to be said:

Any effective agreement relating to disarmament and the elimination of atomic bombs must of necessity provide for measures of inspection of considerable scope. But under present conditions, Russia has valid reasons to keep the location of her key industrial installations secret, and therefore looks upon the Iron Curtain as her most important strategic defense. As long as we continue to regard France, Belgium, and Holland as a base of military operations against Russia; as long as we remain in a position to re-arm Western Germany if we choose to do so; as long as we keep on developing long-range rockets as well as long-range bombers and actually remain in the possession of a considerable fleet of such bombers, Russia will have valid reasons for refusing to enter into any agreement that provides for international inspection of installations on her territory.

I conclude that an agreement between Russia and the United States on atomic disarmament is incompatible with the continuation of our present policy in Europe. We shall have to choose the one or the other; and clearly, this is not a choice to be lightly made.

WHAT USE IS AN AGREEMENT?

Suppose then, for the sake of argument, that we are inclined to choose atomic disarmament and want to secure a peace settlement that would provide for general disarmament as well as the elimination of atomic bombs, is there any way for us not only to obtain such a settlement but actually to secure peace? Is there any way for us to offer France, Belgium, and Holland any security short of militarily counterbalancing the Russian land armies in Europe? To what principles can we look in a search for a method to give these countries security?

These are the questions that I now propose to examine.

At the end of the First World War, peace could have been secured if the Western World had embraced the principle of collective security. The Second World War would probably not have occurred if collective action had been taken against Japan in 1931 when she invaded Manchuria, and failing that, if, by collective action, an oil embargo had been imposed on Italy when she attacked Abyssinia. All this time, Germany was watching on the sidelines, and when Italy was allowed to get away with it, she drew her conclusions.

The thesis that collective security could secure the peace was true after the First World War, but at that time it was rejected; today this thesis seems to be generally accepted, but it is no longer true. At least it is not true where Russia and the United States are concerned.

Russia and America are each militarily so powerful that no likely combination of nations would be in a position to coerce either of them. Moreover, militarily, the more important nations of the world must be considered as allies of either Russia or America and could not be expected to participate in collective action against their ally.

While it is a necessary prerequisite of peace that an agreement be reached between America and Russia, today there is no possible way to enforce such an agreement on the basis of collective security. And here we come to some vital questions:

"What is the use," you may ask, "of concluding an agreement if it cannot be enforced?" You may ask, "Can Russia be trusted to keep an agreement?"

Clearly a general peace settlement will deal with issues that are vital for America and Russia, and when such issues are at stake, nations cannot be trusted to keep an agreement unless the agreement is compatible with their vital interests, and keeps on serving their vital interests.

"What, then," you may ask, "is the use of concluding an agreement if the contracting parties can be trusted to keep it only as long as it suits them to do so?"

As I see it, this is the crucial question, and war or peace might turn upon our finding the right answer to this question.

I believe that today the problem of securing peace reduces itself to the successful accomplishment of two tasks: first, the drafting of an agreement which will reconcile the vital interests of America and Russia; and second, having concluded such an agreement, the adoption by both the United States and Russia of policies that will ensure that the agreement will continue to be in accordance with each other's vital interests. Unless these requirements are met, the agreement will be of no value.

In the absence of any possibility of enforcement, the agreement will be of value only if it is so well balanced and so well adjusted to the real interests of the contracting parties that, if it were to lapse, they would, of their own free will, conclude it anew. An agreement that fulfils this requirement, might be said to be self-regenerating.

Could this requirement be met? I rather believe so.

If we approach the problem of drafting an agreement on the basis of such considerations, then clearly we must not consider our own interests only, but it is equally important to ask ourselves what the interests of our friends in Western Europe are and what the interests of Russia are—what these interests are today and what they are likely to be in the future.

And even though Germany might not be one of the negotiating parties and an agreement might be imposed upon her, we will still have to be fully aware of her vital interests. For if we want to have peace, we shall have to make sure that the agreement does not run counter to her vital interests either.

OUTLINES OF A POSSIBLE AGREEMENT

If we are ever to get an over-all agreement, it is high time that the public discussion of such an agreement should get under way. Naturally the

first tentative proposals will look foolish later, as public discussion reaches a more advanced stage. But because a start has to be made somewhere, sometime, it might as weil be made right here and now. I shall therefore make an attempt to enumerate a number of points which such an agreement might comprise.

The basic philosophy of this tentative proposal is to balance in the agreement a major point in favor of Russia against a major point in favor of America. The agreement centers around a completely demilitarized but federally united Germany, not even precluding the possibility of a union of Austria with Germany.

The point in America's favor would be that this united Germany would be economically integrated with the rest of Western Europe.

The point in favor of Russia would be that America would accept the fact that Russia will have a militarily dominating position on the continent of Europe.

France, Belgium, and Holland would cease to be allies of the United States. They would form a neutral bloc of their own. The United States would guarantee their neutrality in the sense that as long as Russia does not violate the neutrality of any one of them, the United States will respect the neutrality of all of them. With regard to them, the United States would assume a unilateral obligation to go to war with Russia if Russia should invade any of them or force any of them to surrender.

The agreement would provide for a continental customs union in Europe which would include Germany, and freely exchangeable currencies among all the members of that union.

The agreement would provide for the elimination of atomic bombs from national armaments, for general disarmament, and for inspection of sufficient scope to make the provisions relating to disarmament effective.

Before going any further, there are two questions we must settle in our minds:

1. If we permit Russia to occupy such a dominating position in Europe, what then would prevent Russia from overrunning Germany, France, Belgium, and Holland? But perhaps we ought rather to ask what would induce Russia to overrun Germany, France, Belgium, or Holland. For clearly such an invasion would mean war with the United States, and, notwithstanding the degree of disarmament that might be agreed upon, the potential strength of the United States in case of war will remain very great. Russia would therefore hardly provoke war with the United States without some very important reason for doing so.

Naturally, if Russia were willing to fight a world war for the sake of establishing Communist governments in Germany, France, Belgium, and Holland, there is nothing in the setup here proposed that would prevent her from occupying, after some initial resistance, all of Western Europe. There are those who believe that Russia would do just this. Those who believe this must of necessity reject the solution which is being discussed here, but they must also of necessity conclude that there is no chance of achieving atomic disarmament. They are entitled to their opinion, but they ought to draw the logical conclusion from it that there is nothing left for America to do now but to step up the atomic arms race. What that will lead to I do not propose to discuss on this occasion.

The rest of us, who do not go along with that view, must examine whether Western Europe could achieve security short of militarily counterbalancing the Russian land armies. Security based on military strength is not the only way to achieve security, nor does military strength necessarily provide security. And as time goes on and distances shrink, fewer and fewer nations will be able to attain security based on military strength.

The security of Mexico with respect to the United States is not based on military strength, nor is the security of Mexico absolute, and neither is her freedom of action absolute. For Mexico might no longer be secure if she decided to conclude an alliance with Russia and if Russia were to look upon Mexico as a base of military operations against the United States.

I should be inclined to think that Western Europe would be more secure from Russia under the proposed setup than it is today. For even in case of war with America, Russia might hesitate to violate the neutrality of Western Europe, if, by doing so, she would permit the United States to use Western Europe as a base of operations against her.

2. Military action, however, is not the only way by which Russia could conceivably conquer Western Europe. There will be those who think that Russia need not risk a world war in order to conquer Europe; that Russia can conquer it through Communist propaganda.

To me it seems somewhat curious that on the one hand, we tend to underestimate Russia's military power, and on the other hand, we tend to overestimate Russia's political power. Immediately after the war, Russia succeeded in creating Communist governments which are subservient to her in Poland, Rumania, and Bulgaria, and somewhat later in Hungary as well as Czechoslovakia. But in all these countries, Russia succeeded in this because Russian troops had moved in and, under their protection, a police force was established which was subservient to Russia. Yugoslavia, where Russian troops did not move in, has a Communist government, but her government is not subservient to Russia.

The popular concept that in countries like Italy, France, Belgium, or Holland, Russia might gain power through an armed insurrection of a political minority, is not supported by any precedent. To transform a group of civilians in opposition to the established order into a fighting force, that can successfully meet in peacetime the organized military and police force of the established government, is a task exceedingly difficult to accomplish. To my knowledge, it has never been accomplished in any European country in modern times.

* * *

If we thus tentatively conclude that an over-all agreement of the type proposed above is worth considering, then we must now examine the chances of Russia's accepting inspection and of getting inspection to operate in a satisfactory manner.

Should the proposed agreement in fact eliminate Russia's valid reasons for objecting to inspection, would then Russia be likely be welcome inspection?

Even then Russia would probably dislike the notion of inspection and everything that goes along with it. For secrecy is habit-forming as atomic scientists very well know from their own experience. Secrecy tends to persist long after the reasons which brought it into existence have ceased to be operative. You start off with secrecy for the sake of security and you end up with secrecy for the sake of secrecy.

Yet when an agreement is offered to Russia from which she would have

much to gain and which would make secrecy appear unimportant to her, Russia might overcome her reluctance to inspection.

In this respect we have an encouraging precedent in the record of the UNRRA control commissions that operated in Byelo-Russia and in the Ukraine. Here we offered Russia something she wanted—relief, and we asked for something that she did not want to give—freedom of movement for the Control Commission. Russia accepted our terms because she needed the relief. And she continued to keep the terms because she continued to need the relief.

We may dislike the Russian system of government, but at least it has this advantage: once agreement is reached on the highest level there is no sabotaging of the agreement at the lower levels. It might very well be that if we reach an agreement with Russia which provides for inspection, we would encounter even less trouble in Russia with inspection than she might encounter here in the United States.

Yet we must squarely face the fact that the United States or Russia might have grievances arising from the implementation of the agreement and that it is difficult to conceive of any international body to which both countries could entrust the right to adjudicate such grievances.

The only effective recourse that Russia and the United States would have in such a situation would be to record their complaint and to press for a remedy. And, in the absence of any adjudication of the complaint, they can effectively press for a remedy only if they have the right to abrogate the agreement. If either of them fails to live up to the clauses of the agreement which relate to disarmament and inspection, this might involve a vital threat to the other's security. It is, therefore, logical that the United States and Russia should retain the right legally to abrogate in self-defense. Paradoxical though it may seem, it might very well be true that the danger that the agreement will in fact be abrogated is less if Russia and America have the legal right to abrogate it.

It would be advisable, of course, to provide in the agreement for a cooling-off period before an abrogation would become final and go into effect.

Within the framework of an over-all agreement, the problem of Eastern Europe will have to be settled somehow. Shall we reconcile ourselves to Russian domination of Poland, Rumania, and Bulgaria? I think that probably we shall not have much choice in this matter. We might raise the question of Hungary, and it would be even more important to raise the question of Czechoslovakia. For she, among all these countries, is the only one that has a long and successfully established democratic tradition. To return to a democratic form of government in Yugoslavia would also be of importance, but if anything can be done about this, the United States can do more about it at present than can Russia.

If we create a united Germany, one might consider whether the over-all agreement should not provide for the return to Germany, at some fixed future date, of the German territories which have been occupied by Poland. This, in turn, might make it necessary to compensate Poland by the return of at least some of the territories which Poland ceded to Russia with our approval. Because of the increasing domination of Poland by Russia, Russia's reluctance to cede territory to Poland might be less than it otherwise would be.

In this connection, Poland might be given further compensation in the form of large-scale economic aid aimed at the building up of her consumers' goods industries.

Such economic aid to Poland ought to be part of the general economic provisions of the agreement which might promise both Western and Eastern Europe economic assistance from the United States for an extended period of time. The greater Russia's stake would be in the economic revival of Europe, and the longer the period would be for which America would agree to assist in this revival, the greater confidence we could have in continued Russian cooperation.

Of all the problems involved in the making of peace, the most difficult is probably the creation of a prosperous and peaceful Germany—a Germany which is demilitarized and which both Russia and the United States can trust to remain demilitarized.

A necessary condition for a peaceful Germany is to have satisfied those national aspirations of Germany on which the overwhelming majority of the German people are likely to unite. Dismembering Germany, prohibiting Austria from joining a German federal union, or artificially limiting Germany's output of commodities, ought to be ruled out on this basis alone.

But even so, it is a foregone conclusion that in the years to come there will be a strong nationalistic movement in Germany.

How can we be sure that the police forces in Germany will not become subservient to a nationalistic movement? This latter problem cannot be solved simply by decentralizing the German police, for instance by subdividing it into the police forces of the individual German states. For the danger does not primarily lie in the transformation of these police forces into an army, but rather in the possibility that by capturing the police forces, the nationalistic movement may capture the government of Germany. Once that happens, then demilitarization of Germany could be enforced only by armed intervention which would upset the stability of Europe.

But even assuming the police force to be safe, if Germany is a democracy patterned on the Weimar Republic, a nationalistic movement might legally capture the government. What kind of political structure could we give Germany that would preclude this danger?

Superimposing some inter-allied control commission upon the government of Germany would hardly provide a workable solution to this problem. The creation of a supra-national governmental authority in Europe might solve it, but few countries in Europe would at present be willing to accept the restrictions which such a solution would impose on national sovereignty.

The question of Germany's political structure thus poses a problem which is probably incapable of a solution within the framework of established precedent. Something new, something imaginative, may have to be adopted. Perhaps we ought to base our thinking on the fact that the countries in Europe are strongly interdependent. What the German government does affects not only Germany, it affects all of Germany's neighbors. Perhaps it would be possible to base the government of Germany on a political structure that would take into account the fact of this interdependence. But to elaborate upon this point would go beyond the scope of this paper.

We have concerned ourselves here almost exclusively with the Russian-American conflict. There are other conflicts in the world which require attention. But if the Russian-American conflict is settled, the United Nations will come into its own. The edifice of the United Nations was erected on the premise that the great powers would act in agreement with each other. When that premise holds true, the United Nations will be able to function as it was meant to function.

(Continued on page 16)

AN INTERIM PLAN FOR INTERNATIONAL CONTROL OF ATOMIC ENERGY

David F. Cavers

The proposal presented below recognizes and explores the altered status created by the Soviet achievements in atomic energy. Mr. Cavers has discussed the problem of international control in articles appearing in the October, 1947, and December, 1948, "Bulletin." He is Professor of Law at Harvard University.

KNOWLEDGE that the Russians have been able to bring about an atomic explosion has done more than kindle new hope and desire for the international control of atomic energy; it has made possible a new kind of agreement: interim agreement. As long as the United States considered itself the sole possessor of the secret of nuclear fission, no plan that did not promise permanence of control could provide an adequate incentive for disclosure. But now that Russia—and doubtless Britain, Canada, and France—have mastered the basic techniques, we can seriously consider proposals for control that postpone permanent solutions to a future in which relations between West and East may have grown less tense.[1]

It is important to note, moreover, that *we are in an interim*, the interim between discovery of the use of nuclear fission in bombs and development of its use for industrial power. While this interim continues, and it may well last ten or twenty more years, we shall lack facts essential to design an adequate permanent control plan. For example, the control problem would be greatly affected by the responses to the following three questions, none of which appears as yet to have been answered:

1. If, as seems probable, the large-scale use of atomic power requires nuclear reactors capable of "breeding" nuclear fuel, can these be developed and, if so, will low-cost power prove possible?

2. If nuclear reactors can be developed to produce low-cost power, will these have to be limited to large-scale plants requiring a huge demand for economic operation?

3. Can secondary nuclear reactors be developed that will use "denatured" fuel to produce low-cost power?

Not only do such basic uncertainties make permanent planning in the current period impracticable, but in this period the problems of temporary control are eased by the fact that at present non-military needs for nuclear fuel production are low. As long as this situation continues, the difficulties and dangers incident to the control of large-scale facilities and stockpiles can therefore be minimized.[2]

THE DANGER IN DELAY

Perhaps one of the most pressing reasons for examining an interim plan of control is the fact that the longer international control is delayed, the less security any control plan can give. This is due to the difficulty of finding out just how much nuclear fuel has been produced by any nation between the start of operations and the inception of control. The inadequacy of periodic inspection of nuclear facilities has been repeatedly stressed, but, for the time span antedating control, there will have been no inspection whatsoever. Hence, all nations must rely on accounting measures and such back-checking by the control agency as may be practicable for assurance that the producing nations have not withheld substantial quantities of atomic explosives from their prior output.

The longer the period before control, the less adequate can be the assurance given by the control agency and the more sinister the significance of the margin of error. Indeed, the fact that, despite this patent uncertainty, the United States still asserts its interest in control indicates that our policy-makers no longer insist upon absolute atomic security. Evidently, they are willing to run the risk that some bombs may be secreted by a nation party to the control plan. But, once this position is taken, it is scarcely possible to insist on air-tight control for the future. Clearly the same test should be applied to future as to past production: will the plan prevent the accumulation of enough bombs to give the nation possessing them a substantial advantage in case of war?

AN INTERIM PLAN PROPOSED

In the current impasse, naturally enough, official discussion of the problems involved in designing an interim measure is discouraged, but this fact renders unofficial speculation all the more appropriate. With this in view, the following proposal for an interim plan of control is put forward as a target for discussion.

The interim plan would be embodied in one or, if the USSR should still insist, two, conventions forbidding the use of atomic weapons, creating an international control agency, and setting rules of control to continue for a prescribed period of years. This period would be fixed on the basis of scientific estimates of the time likely to elapse before nuclear fuel can be used economically for industrial power, perhaps ten years, perhaps twenty, perhaps some intermediate period.[3]

Provision could also be made to terminate the plan earlier if the control

[1] This assumes, of course, that our national policy is to participate in an effective control plan at the sacrifice of whatever deterrent and retaliatory values our possession of the atomic bomb confers. If this is not our national policy, official statement of that fact is called for.

[2] This consideration was noted in the letter by President Carlos P. Romulo of the U.N. General Assembly to the six permanent members of the U.N. Atomic Energy Commission. For text, see *Bulletin*, V (December, 1949), 345.

[3] That early expectations as to the rate with which atomic power would supplant conventional sources have been overly sanguine is indicated, even for the power-poor countries, in Isard and Lansing, "Comparisons of Power Cost for Atomic and Conventional Steam Stations." *Rev. of Economics and Statistics*, XXXI (August, 1949), 217. See also Isard and Whitney, "Atomic Power and Economic Development," *Bulletin*, V (March, 1949), 73–79.

agency (or any signatory nation) demonstrated that the use of nuclear fission for industrial power had become economic. Certain specific, objective criteria of economic use might be prescribed in the control convention, and satisfaction of the terminating condition could be proved by reference to them. Such termination should not be immediate, however; a terminal period of a year or two should be provided so that a new control plan might be negotiated in the light of the new situation.

NUCLEAR FUEL OUTPUT IN THE INTERIM

While the interim plan was in force, there would be only two non-military reasons to produce nuclear fuel in dangerous quantities. One of these would be to provide enough fuel for experimental development work and pilot-plant operations looking toward the use of atomic power for industrial purposes. The other would be to build up a huge stockpile of nuclear fuel to supply industrial power reactors as soon as such reactors were developed on an economic basis.

As for the first of these purposes, it is very likely that the stockpiles already built up by the United States and the USSR would prove more than sufficient. The second purpose is open to challenge. To pile up nuclear fuel by operating large reactors would endanger world security for a very dubious gain. Granted that production operations over a span of years will be needed to supply power reactors with large quantities of fuel when, as, and if, economic designs are developed for general use, still it seems unrealistic to assume that the introduction of nuclear reactors will be a rapid process.

Probably the first usable reactors will neither be very efficient nor very dependable, while the capital investment they will entail will be very large. Hence the prospect of improvement in design, plus the diseconomy of displacing nearly as economic conventional plants, will mean introduction of the reactors at a gradual rate, chiefly to supplement existing plants. This will permit timely provision of an adequate nuclear fuel supply once the need for it becomes evident. Continuous production in the interim will be unnecessary.[4]

[4]The Second Report of the UNAEC seems to recognize this as likely in its highly significant and generally overlooked Specific Proposals XI (c) and XII of Part II, Chapter 5. These restrict the provision of dangerous facilities to those "where economic justification exists" and confine the output of nuclear fuel suitable for weapon use to "the minimum required for efficient operating procedures necessitated by actual beneficial uses, including research and development." Only a strained construction of the latter proposal would authorize operation of any of the existing large-scale reactors whatsoever until the need to supply atomic power plants had actually arisen.

These considerations point to the possibility of eliminating all large-scale operations save those connected with developmental work while at the same time requiring no significant sacrifice of the economic interests of any nation. But how about the developmental work itself, how about the existing stockpiles and facilities, how about inspection? These questions will now be examined.

DEVELOPMENTAL WORK IN THE INTERIM

The scientific and engineering work essential to development of the industrial uses of atomic power appears to fall in two categories. First are operations that can be carried out in laboratories using relatively small reactors and small quantities of nuclear fuel. Perhaps some of these facilities and fuel supplies would be "dangerous" as that term has been used in the UNAEC reports, but, in view of the approximate character of the security which any plan can now achieve, that standard seems needlessly strict. Hence the interim plan could tolerate the existence of such laboratories in the signatory nations, subject to a prescribed over-all ceiling.

The second category comprises operations that call for reactors of substantial size. Some indication of the types of reactors needed is given in Dr. Robert Bacher's article in the *Bulletin* for March, 1949, in which he describes the USAEC's reactor program. Eliminating the reactors primarily military in character, the program would call for a materials testing reactor, a high energy "breeder" reactor, and an intermediate energy "breeder" reactor. The materials testing and the high energy reactors are to be built at a remote Idaho site, according to a press release announcing the letting of the contract for the latter.[5] The intermediate energy reactor is to be built near Schenectady, New York.

THE LOCATION OF "DANGEROUS" REACTORS

But if, as is probable, such reactors as those are "dangerous," where should an interim plan require that they and their stockpiles of nuclear fuel be placed? Here the interim plan should break sharply with the principle of strategic balance and thus escape the obstacles to agreement, the suspicion, and the fear that its application would almost certainly create. In lieu of strategic balance, there should be substituted a plan of concentrating dangerous developmental activity at a single point which would be so vulnerable to destruction by both sides in case of world war that its control would be militarily valueless. The construction and operation of developmental reactors at this point would be the function of the control agency. Thus both the risk of diversion of fuel and the inducement to seize the agency's facilities would be negligible.

To determine the location of a bilaterally vulnerable point would, of course, be a matter both for military expertise and for scientific appraisal. The point should be well within bombing range and should not be fortified. It should be reasonably accessible and, preferably, should possess adequate power resources. Needless to say, the consent of the inhabitants would have to be obtained. These considerations suggest that the control agency would have to acquire a reservation for its operations sufficiently large so that, if hostilities were to break out and the facilities were demolished, the violence could be confined to the reserved area without jeopardizing the safety of the inhabitants.[6]

At the point for its developmental center, the agency could establish an institute of advanced nuclear studies at which physicists and engineers from all parts of the world could pursue intensive work in the problems incident to the production of industrial power from nuclear fuel. Moreover, any individual nation, if dissatisfied with the agency's research program, should be free to construct facilities of its own design there, the operation to be under close agency scrutiny.

DISPOSING OF EXISTING STOCKPILES

As was noted above, the nuclear fuel needs of all these operations might be satisfied from the stockpiles already accumulated by the United States and the USSR. This suggests a solution to a thorny problem that has never been resolved in specific terms in the UNAEC's reports: how to dispose of the existing supply of atomic explosives.

[5] See page 31-32 of this issue. Estimated costs are $25, $35, and $40 million respectively.

[6]By way of illustration, two points may be noted as possible seats of the international developmental center, their peoples consenting. These are Iceland and the Faroe Islands. Their climates are temperate, if not inviting. Their populations are small, and at least the former has abundant room for any reservation that might be desired. The hydro-electric power potential seems more than adequate. Communication with Europe is relatively easy and with North America not difficult. The American nuclear physicist should compare them, not with his university town, but with Arco, Idaho; Hanford, Washington; and Los Alamos, N.M.

At or near the developmental center, a large storage area could be set aside for the deposit of nuclear fuel not immediately required for use in the various developmental reactors. Surplus equipment from existing facilities and material of value, such as moderators, might also be stored there. This storage area, with its priceless and perilous wares, could be placed under the concurrent guard of separate forces representing the control agency and any individual nation which wished to maintain control forces there. Access to the area would require the joint acquiesence of all the guarding forces as would the withdrawal of stored material or equipment. Finally, each guard force would be equipped with independent means of detonating mines so placed in the storage area as to prevent the seizure of its contents. Such precautions could certainly be perfected to a degree which would render diversion or seizure from the area as unlikely as the burglarizing of Fort Knox.[7]

The need to elaborate such precautionary measures is, of course, an obstacle to winning acceptance for this or, indeed, any control plan. Not only does it invite Mr. Vishinsky's sarcasm; it gives the plan a gadgety look to plain-dealing men who prefer simple arrangements, and it renders uncomfortable the good folk who don't like even to lock their own doors. Unfortunately, however, there is no easy solution to the question where and how to store enough nuclear fuel to blow half the major cities of the United States off the map. Under any control plan, if this costly material is to be preserved for future peacetime use, security measures must be devised that satisfy this country and all other countries that that material is seizure-proof. No doubt part of the process of adapting to life in an atomic world is getting used to the strange institutions as well as the strange mechanisms that its needs will call forth.

DISPOSAL OF EXISTING FACILITIES

If dangerous developmental facilities and stockpiles are to be concentrated at a single point, what disposition should be made of existing large-scale facilities? Here a policy choice seems open. The first alternative can be designated as a high-security policy. This would call for the dismantling of all large-scale facilities and possibly for their demolition. Demolition would be important from a security standpoint only if, in case of war, it would be the construction of new works rather than the manufacture of new equipment that would govern the time required to produce a militarily significant quantity of bombs. Whichever course was followed, specialized equipment and materials of high value could be transferred to the new developmental facilities or deposited in the storage area.

The prohibition of all national large-scale facilities for the interim period would eliminate the hazards of diversion and seizure, leaving only the hazard of clandestine construction and production to be guarded against by inspection. Moreover, the task of inspection would be materially eased if no large-scale operations were lawful, since secret illicit operations can best be carried out under cover of the lawful. Hence, the adoption of the high-security policy would greatly diminish pressure to maintain conventional offensive and defensive armaments at a high level as assurance against the breakdown of control. Finally, the adoption of this policy would eliminate problems of plant design and plant inspection and of strategic balance in the location of plants.

AN ALTERNATIVE POLICY

Despite these weighty advantages (which, I submit, outweigh the conjectural gains that might accrue from continuing to build up the world's supply of nuclear fuel), the political obstacles on both sides to the high-security policy are formidable. The appearance of economic waste is not easily dissipated even when what is shut down is a heavily subsidized enterprise. Russian sensitivity on the score of sovereignty is also to be reckoned with. Hence it is necessary to examine the possibility of achieving substantial security under a plan permitting the continued operation of existing facilities.

Under an interim plan, of course, international ownership of these facilities could not be required. Reliance would have to be placed on a chain of inspection starting with the mining operations. The critical element in the plan would concern the disposal of the nuclear fuel which was produced or separated. This should be deposited with the control authorities in the central storage area to the account of the depositing nation, to be released only when the interim plan ended or a permanent plan permitting such release was adopted. (Small amounts could be released to supply small-scale national laboratories.)

With the output of nuclear fuel deposited in a secure place, the operation of national reactors, if continued, would neither build up an increasing temptation to seize stockpiles nor accentuate the problem of strategic balance. If, however, there should prove to be a considerable disparity between the facilities in this country and those in Russia, probably the nation with the smaller capacity would insist on some equalizing measure. For example, this might entail the dismantling of the gaseous diffusion plant at Oak Ridge while the reactor at Hanford was kept in operation.[8]

THE PROBLEM OF INSPECTION

If the high-security policy were to govern the disposal of existing facilities, the problem of inspection would, as has been noted, be confined to that involved in preventing clandestine activities. To be sure, it would be necessary to maintain some check on the operation of permitted national laboratories, but here the ends of security and dissemination of scientific knowledge could be simultaneously advanced by provision for representation of the control agency on the staffs of all these laboratories, with right of access to all their activities. Since there would be no large-scale dangerous facilities to be watched, the problem of periodic versus constant inspection to prevent diversion would not arise.

The prevention of secret activities would be considerably eased if the agency had made a thorough check of

[7] To devise ways of destroying a metal or rendering it inaccessible or unusable, even in relatively small quantities, would not be easy, especially since the action should be of such character as to offer no reasonable hope of salvage by operations conducted over a considerable period of time. Obviously the entire supply of fissionable material could not be exploded, but the explosion of some portion of it might aid materially in blocking access to the rest of it. Man has proved so adept in destruction that it seems unlikely that this assignment would overtax his powers. A touch of Jules Verne might be called for. Thus one possibility might be to use as a depository the ocean floor off the coast at a point where prevailing tides or seas made underwater operations extremely difficult. The fissionable material could be so distributed that, upon detonation of its containers, it would be scattered in small fragments over a large area at the bottom.

[8] It should be noted, incidentally, that the alternative policy just stated is not unlike that embodied in Specific Proposals XI (*c*) and XII in Part II, Chapter 5, of the Second Report of the UNAEC, briefly outlined in footnote 2, *supra.*, except for the means of disposing of the output here suggested. Indeed, a proper construction of those proposals would seem to call for a complete shut-down of the production of nuclear fuel in all existing facilities and for a ban on expansion until marked progress toward the economic exploitation of atomic power had made the building up of a stockpile for this purpose an "actual beneficial use."

all supplying industries in verifying the initial accounting for nuclear fuel output antecedent to control by the United States, Russia, and any other producing nations. This would require checking not only the operations of the separation plants and reactors that had been declared, but also the output of the declared mines, wherever located;[9] the operations at all intermediate steps; and, finally, the secondary supplying industries, e.g., the producers or refiners of moderators, the manufacturers of instrumentation, wherever located.

Such a check, even though it were short of the goal of complete verification, would identify key points to be watched in the course of future control activity. Such surveillance would not require constant inspection but, to be effective, might call for more than the periodic reports from secondary industries provided for in Specific Proposal XV of the UNAEC's Second Report, Part II, Chap. 5.

Another mode of checking secret operations would be the registration everywhere of scientific personnel, including advanced students, trained in the special fields essential to nuclear operations. Periodic checks as to their whereabouts and activities would increase the difficulty and hazards of developing an entire illicit system of production.

CONSTANT VS. PERIODIC INSPECTION

If the high-security policy were not followed, then the issue of constant versus periodic inspection would be difficult to avoid. It is hard to deal with the issue objectively since it seems so palpably false. Since, however, the Russian insistence upon periodic inspection has been so emphatic, a method of achieving substantial control without requiring the constant attendance of inspectors at reactors is to be welcomed. And, since, in the case of reactors producing plutonium, the operation of withdrawing the fissionable material from the reactor appears to be a difficult one, might not requirements as to reactor design be imposed which would so extend the withdrawal operation over time that it could almost certainly be detected by inspectors making frequent visits to the reactor at irregular intervals?

[9]It would also be necessary, of course, to verify reports as to the location of all uranium and thorium deposits. As is made clear in Specific Proposal III, Part II, Chap. 3, of the UNAEC's Second Report, this would not require indiscriminate touring of the reporting nation's territory by teams of inspectors, and the likelihood that importantly significant military information would be incidentally acquired seems small. Therefore, this phase of the institution of a control plan, though requiring careful treatment in the control convention, should not afford genuine grounds for disagreement.

If this could be done, the importance of continuous inspection would be considerably diminished, especially when the relative character of the security achieved by any controls is kept in mind. Illicit removal would be so gross a violation that it would scarcely be chanced if the risk of detection in the process were at all substantial.

SANCTIONS

In this interim plan, as in any permanent plan, problems of sanctions in case of violation would be difficult, but the real deterrent to violations would be the risk that war would be precipitated, especially the risk of detection before a substantial advantage over other nations had been gained. This risk of war would, of course, be appraised in brutally realistic terms, since only a malevolent nation would have occasion to assess it. A unilateral declaration of national policy on this point might therefore be more potent than clauses in any control agreement. Such a declaration might simply state that violation of the control plan in circumstances indicating intent to gain military advantage would be interpreted as a act of "armed attack" within the meaning of Article 51 of the United Nations Charter.

THE TIMING OF PROHIBITION AND CONTROL

Would an interim plan be able to circumvent another obstacle to agreement—Russian insistence that the use of atomic weapons be prohibited simultaneously with the effective date of the control agreement? No answer to this problem seems derivable from the interim character of a plan, but obviously bilateral possession of nuclear fuel has eased the timing problem. This fact makes possible the following solution.

The convention prohibiting atomic weapons should go into effect at once, but the actual surrender of the atomic bombs and fuel should be required only after the expiration of three months, as the Russians themselves have proposed,[10] *and upon the certification by the control agency that it had completed verifying the accounting of all other producing nations and that those nations were prepared to surrender atomic bombs and fuel to it in accordance with the verified accounts.* Perhaps this accounting (which would have to be approximate) could be completed in three months, but, if a longer time were required, no nation would be obliged to turn over its nuclear materials until all nations had made an accounting.

Given, not reciprocal trust, but the will to enter into an arm's length agreement, the problems of devising a fair and secure interim plan could almost certainly be solved. And if such a plan were in operation for a decade, perhaps mutual trust would begin to take the place of suspicion and fear. Then, if science had found answers to the problems now unsolved, would come the time for a permanent control plan. Failure to reach agreement then, even if not followed by an extension of the interim controls, would leave us and the other nations of the world no worse off, and very probably better off, than we all are now.

[10]A period of three months from the effective date for destruction of "all stocks of atomic energy weapons" is provided in the Draft International Convention submitted by the USSR at the second meeting of the UNAEC, June 10, 1947. The text appears as Annex 3(*a*) of the UNAEC's Third Report.

Can We Have International Control of Atomic Energy?

(Continued from page 12)

In the absence of a settlement in the Russian-American conflict, the danger that the atomic arms race will now begin in earnest is very great, and the risks that this will involve for ourselves, as well as for all mankind, is incalculable. The over-all agreement proposed here might not be favored by those whose only concern is that the United States shall be in the best possible strategic position if war comes. But unless we are willing to accept a less favorable strategic position for the sake of greatly improving our chances of attaining peace, we might be unable to make any progress toward peace.

Because it may take time to reevaluate our foreign policy, it might be necessary to arrive at some informal agreement with Russia to make sure that in the meantime no irrevocable decisions are taken on the German issue by either Russia or America.

Any attempt to make a new start and to try to negotiate with Russia on the issue of atomic disarmament without being ready to remove the major obstacle that stands in the way of agreement, i.e., without being ready to settle the basic strategic conflicts in Europe, can only lead to disappointment. The negotiations on atomic disarmament have failed once, and that is unfortunate. Allowing them to fail a second time might be disastrous.

A PROPOSAL FOR AN ATOMIC ARMISTICE

Cuthbert Daniel and John L. Balderston

The following letter was addressed to the delegates of the United Nations General Assembly on November 21, 1949, by two engineers formerly employed at Oak Ridge National Laboratory. Several articles by Mr. Daniel, written in collaboration with Arthur M. Squires, have appeared in previous issues of the "Bulletin."*

WE—TWO ENGINEERS recently at Oak Ridge—heartily endorse President Romulo's appeal for a short-term atomic armistice, accompanied by an adequate inspection system, and we urge that his proposals be given thorough study.

There remains a possibility for further compromise between the majority and minority plans for atomic energy control: a realistic assessment of the present peaceful uses of atomic energy may point the way toward an international agreement which would obviate the need for international ownership and management of atomic facilities. A greatly simplified inspection system would then be possible.

ISOTOPES THE ONLY BENEFIT NOW

At the present moment, there is only *one* peaceful use of atomic energy. It is the use in research and in medicine of radioisotopes. These marvelous new tools, always used in very tiny amounts, are made in a low-level atomic furnace.

The reactor at the Oak Ridge National Laboratory is typical. It was built in 1943 at a cost of only 12 million dollars. (More than a billion dollars has already been spent or allocated on the huge production piles at Hanford.) At the present time, this small Oak Ridge pile is producing all of the isotopes shipped by the U.S. Atomic Energy Commission for use at home and abroad. Last year 2,644 orders were filled, and this year's orders will probably number 4,000.

Yet this Oak Ridge pile, working at full capacity, would take *ten to twenty years* to produce enough plutonium to make just one atomic bomb. And without a very special plant to separate this plutonium from the dangerously radioactive fission products with which it is always produced, a bomb could *never* be produced.

Four such low-level reactors could produce all the radioisotopes the world could possibly require in the next few years. Under no circumstances would it be possible to convert them into A-bomb plants. They could be located anywhere in the world without constituting any military threat whatever.

Isotope piles—operating at perhaps 5,000 kw. or less could be checked on by an international force on Mondays and Thursdays—and the world could still be safe from surprise atomic attacks. Moreover, the isotope plants could safely be operated by national rather than international authorities.

In sharp contrast to the vast and dangerous Hanford-type installations, radioisotope plants make very moderate demands on the world's limited uranium resources. We estimate that about 20 tons of natural uranium per year would be needed in each such plant —80 tons a year for the whole world.

Compare this with the rate at which the United States is using uranium. We purchased 3,650 tons of uranium from the Belgian Congo in 1946, according to reports published in Brussels.

ATOMIC POWER A REMOTE PROSPECT

In regard to "atomic power"—the proposed large-scale use of fissionable materials for economical power production—reasons have been given elsewhere (*Bulletin of the Atomic Scientists*, April-May, 1947) for doubting the favorable picture painted by non-engineers. It is sufficient here to refer to the statement of the U.S. Atomic Energy Commissioner Sumner Pike, who has said that it will be ten to twenty years before anyone will be in a position to make an intelligent guess about the prospect for economic atomic power.

Research in this field requires fairly sizable piles, capable—if supplemented by large processing plants—of producing around one atomic bomb per year. Hence, some inspection would be needed. If these experimental piles were "sealed"—the fuel being sealed inside and only a few experimental slots in the pile remaining open—periodic inspection should be quite safe.

LARGE-SCALE PLANTS TO BE OUTLAWED

Under this proposal all large-scale use of atomic explosives would be prohibited. This involves no sacrifice. The use of atomic energy in blasting operations would be not only uneconomical but highly dangerous, because of the lethal quantities of radiation that would remain on the site. Our proposal maintains all the peaceful benefits of atomic energy.

It will be much easier to inspect the world for large-scale plants if no such plants are legal. It is obviously much easier to *detect* a big atomic industry that is illegal than it is to *police* a big atomic industry that is operating legitimately in all countries. Thus international inspection, while still an absolute necessity, can be put at its minimum rather than at the maximum now proposed. Inspection could safely be placed on a periodic or "Monday and Thursday" basis, and atomic facilities could be nationally owned.

When atomic power becomes economically feasible in this or any other country, the atomic armistice can be reconsidered. In the meantime, the present proposal, by by-passing some of the points that have caused the present deadlock in atomic negotiations, offers a basis for further discussions within the United Nations.

*"The International Control of Safe Atomic Energy," *Bulletin*, III (April, 1947), 111–16; "An International Moratorium on Atomic Energy for Power Uses," *Ibid.*, IV (June, 1948), 183–84; "Freedom Demands Responsibility," *Ibid.* IV (October, 1948), 300–304; and "Scientists' Responsibilities," *Ibid.*, V (January, 1949), 27–28.

UNITED NATIONS ATOMIC ENERGY NEWS

Francis W. Carpenter

Mr. Carpenter, who reports the activities of the United Nations Atomic Energy Commission for the "Bulletin," is a member of the staff of the Associated Press. He has covered the work of the UNAEC since its first meeting in June, 1946.

THE most important and grave issue before the Fourth United Nations General Assembly last fall was: what to do about atomic energy? The Assembly did not arrive at any solution because of the continuing East-West conflict, but it did instruct the six Sponsoring Powers to keep on talking about the problem.

DEBATES IN POLITICAL COMMITTEE

During October and November Vishinsky carried the fight to the West with long speeches both in the Ad Hoc Political Committee and in the plenary session. There were indications, however, that even the Foreign Minister of the Soviet Union was not completely cognizant of everything about atomic energy going on in his broad land.

President Truman startled everyone September 23, 1949, with his announcement that there had been an atomic explosion in the Soviet Union. Vishinsky kept silent on the subject until November 10, letting a Tass communique merely say that the Soviet Union had atomic weapons at its disposal.

Vishinsky Claims Constructive Uses of Atomic Energy in Soviet Union

But on November 10, the grey-haired Foreign Minister strode briskly to the Ad Hoc Political Committee, jumped all over the Western position on atomic energy as usual and then intrigued the Committee with this look behind the Iron Curtain:

"We in the Soviet Union," he said, "are utilizing atomic energy, but not in order to stockpile atomic bombs—although I am convinced that if, unfortunately and to our great regret, this were necessary, we should have as many of these as we should need—no more and no less. Right now we are utilizing atomic energy for our economic needs in our own economic interests. We are razing mountains; we are irrigating deserts; we are cutting through the jungle and the tundra; we are spreading life, happiness, prosperity, and welfare in places where the human footstep had not been seen for thousands of years."

Hickerson Discounts Soviet Claims

John D. Hickerson, Assistant Secretary of State, replied on November 11. He said that Vishinsky had told the Committee that atomic energy was being used in the USSR "for such peaceful purposes as moving mountains, irrigating deserts, and clearing jungles." He implied this was so much nonsense.

Hickerson said that if nations have devices which can level mountains, they also have in their possession devices which can level cities.

"The United States," he said, "has not overlooked or neglected the peaceful side of atomic energy, even though we have not attempted anything so spectacular as mountain moving. For example, for some time the UNAEC has been distributing, either free or at very low cost, isotopes for medical and research purposes to any and all countries which desire them. To date, I believe some thirty countries have received shipments. Soviet scientists are offered the same opportunities that have been given scientists of other countries, providing they comply with the conditions applicable to all. These conditions merely call for a collective and open sharing of scientific results and developments. What is the Soviet Union doing to share the knowledge of the peaceful uses it has developed?"

Vishinsky Replies

Vishinsky took up the challenge the next day and he also attempted to set the record straight on the business of moving mountains.

"Our requirements of atomic energy are tremendous, and they are growing," he told the Ad Hoc Political Committee. We endeavor to meet these requirements as they come up, and in endeavoring to meet these requirements, we use our atomic energy for peaceful purposes.

"Statements were ascribed to me about moving mountains with the help of atomic energy. Well, perhaps you thought of the report in some German newspaper (the Soviet-licensed Berlin newspaper *Nacht Express)* but let the responsibility for that lie on the German newspaper. I did not talk about moving mountains; I talked about blowing up mountains, razing mountains. In our country, as has been officially stated in the Tass communique (September 25, 1949), and this is what I referred to, there is large-scale explosive work taking place. These projects which require explosive activity are carried out with the help of atomic energy.

"We are told that the people of the United States also use atomic energy for eleemosynary purposes—for instance, they are handing out atomic isotopes for medical research. Well, everybody is acting for welfare according to his own construction. Perhaps thirty packages of atomic isotopes will make mankind happy and blissful for the rest of its days. I do not dispute that point. But the fact is that we are using atomic energy for large-scale explosive projects. What is an explosive project? It involves explosion, blowing up things. Blowing up what? Pieces of rock. After all, we are not going to just shake the air."

A comparison of Vishinsky's remarks as reported in the official verbatim text of the U.N. and as published in the Moscow newspaper *Pravda* on November 17 is interesting—and it shows a marked difference.

The *New York Times* reported that *Pravda* quoted part of Vishinsky's speech as follows:

"We are utilizing atomic energy for our economic plans in our economic interest. We are putting atomic energy to the fulfillment of great tasks of peaceful construction. We want to put atomic energy to blowing up mountains, changing the course of rivers, irrigating deserts, laying new lines of life there where the human foot has rarely stepped."

Asked about the discrepancy in his speech here and how it was printed in *Pravda*, Vishinsky had nothing to add. He made it quite clear that he intended to add nothing.

In the final Committee debate on November 12, Vishinsky said that the Soviet Union had offered—two years ago—to open its doors to inspection and atomic control. He said this was done in the Soviet proposals of June 11, 1947.

These proposals, forming the backbone of the Soviet plan for control, were rejected by the U.N. Assembly in Paris in November, 1948.

Vishinsky said, however, that Russia would never give up one bit of its soil to ownership by an international commission.

The West generally answered Vishinsky with a restatement of its aims and beliefs, and the West this time obtained a greater majority for its view. The fact that Russia has an atomic weapon—so it is reported—apparently made no difference to the small and medium countries, for they sided with the West in support of the majority plan of atomic control. In 1948 the vote in Paris for the Majority plan was 40 to 6.

Haiti's resolution of November 9, 1949—asking the Assembly to outlaw atomic weapons and to begin drafting a convention specifying that this ban and the establishment of controls should begin simultaneously—was withdrawn in the Ad Hoc Political Committee without action.

India's resolution to put the issue before the International Law Commission was defeated, 15 votes in favor, 24 against, and 18 abstentions.

The Committee defeated—paragraph by paragraph—the Soviet Union resolution[1] calling upon the UNAEC to resume deliberations and draw up conventions for simultaneous prohibition and control.

An Argentine resolution calling for renunciation of the use of atomic weapons for purposes of aggression was defeated, 15 votes in favor, 20 against and 23 abstentions.

The Canadian-French resolution[2] asking the Sponsoring Powers to continue consultations was approved by the Ad Hoc Political Committee by 48 votes to 5 (slav bloc).

Vishinsky assailed it as a "mere conglomeration of pious wishes" but he did not close the door to further talks with others of the Sponsoring Powers.

DEBATES IN THE GENERAL ASSEMBLY

In some ways the United Nations lost what little ground it had gained on atomic energy. The Soviet Foreign Minister, Andrei Y. Vishinsky, made some startling statements during the heated debates in the plenary session. In one, he ridiculed the majority plan for a quota system, an idea which his delegation thought, in 1948, might have some possibilities.

Assembly Agrees to Continue Six-Power Consultations

There was not one single point on which Vishinsky and his opposition agreed by the time the debates had ended. But the West gained some ground in the voting, for its proposal to have the Sponsoring Powers continue talks was approved by the General Assembly on November 23, 1949, by a vote of 49 to 5. The Soviet bloc of five—one less than last year because of the Tito-Stalin row—alone opposed the majority. Three countries abstained—Israel, South Africa, and Yugoslavia.

The Western proposal actually was the Canadian-French resolution presented to the Ad Hoc Political Committee on November 7, and finally revised on November 12, 1949.

The Soviet Union resolution (previously rejected in the Political Committee) was defeated in a paragraph by paragraph vote in the Assembly on November 23.

The first paragraph was rejected by a vote of 50 to 5 (Yugoslavia abstaining); the second paragraph, by 51 to 5 (Yugoslavia again abstaining); and the third paragraph was defeated by 41 to 6 (Yugoslavia voting with the other slav states and 10 nations abstaining). Those abstaining were Afghanistan, Costa Rica, Egypt, Ethiopia, India, Iran, Iraq, Israel, Mexico, and Yemen.

Romulo Appeals for a New Approach

After the final action by the Assembly on the two main resolutions sent up from the Special Political Committee, Brig. Gen. Carlos P. Romulo, Assembly President, made a short statement to the Assembly. He appeared to be deeply moved at the lack of concrete action by the Assembly, and his voice was somewhat emotional as he said:

"The [Canadian-French] resolution which the General Assembly has just adopted is a great and impressive act of faith, faith in the principles of the Charter, faith in the possibility of agreement on the most difficult and most compelling problem of our time.

"Much devoted work has gone into the proposals on atomic energy which have been under consideration for the past three years. The discussions in the General Assembly, the Security Council, and the Atomic Energy Commission have produced much information and have clarified many points of view. But the deadlock still persists.

"On November 9, in my capacity as President of the General Assembly, I addressed an appeal to the six permanent members of the Atomic Energy Commission to continue by every conceivable means to seek agreement on an effective system of control and prohibition of atomic weapons. Specifically, I suggested that attention be directed along four lines. Firstly, the possibility of a short-term atomic armistice accompanied by an inspection system. Secondly, the possibility of an interim prohibition on the use of atomic weapons with adequate safeguards. Thirdly, the possibility of further compromises between the majority and the minority plans for atomic energy control. Fourthly, the possibility of a new approach to the fundamental problem of control. I made it clear that I was not advocating any particular plan. The four points are merely indications of four paths which should be explored.

"I will say nothing more about these suggestions except to reject as supercilious and unfair the criticism that these proposals or any other that may be advanced are 'naive.' It is a common error to distrust a solution merely because it seems too audaciously simple. The many learned men who have applied themselves to this problem have been either atomic scientists or political thinkers who know all the physical and political equations involved in this problem. Yet I dare say that none of them, having the innate modesty of greatness, will deny a hearing for any proposal which attempts to inject the human factor into the mechanical equations that seem, so far, to be leading us nowhere.

"It is gratifying to note that, in your resolution, the permanent members of the Atomic Energy Commission are requested: 'to continue their consultations, to explore all possible avenues,

[1] Published in the *Bulletin*, V (December, 1949), 347.

[2] This resolution was published in *Bulletin*, V (December, 1949), 346.

and examine all concrete suggestions with a view to determining whether they might lead to an agreement securing the basic objectives of the General Assembly in this question.'

"The permanent members are now under grave responsibility to the General Assembly and to the world. They have been asked to explore all possible avenues and examine all concrete suggestions. We do not expect that an entirely new plan will suddenly be discovered and unanimously accepted. But we do have a right to expect open-minded consideration of every possibility of reaching agreement on an effective means of control, which at the same time will make possible an agreement on the prohibition of atomic weapons.

"The atomic energy problem has become part of the context of international strife and tension which has dominated the postwar period. This fact makes solution more difficult, but it also makes solution more urgent. Every step taken toward the amelioration of our political problems, every move toward the relaxation of tension and suspicion, is a step toward solving the problem of atomic energy. The reverse is equally true, because all our problems interpenetrate, and the slightest progress we can achieve on the problem of atomic energy would immediately cast a more hopeful light on all the other questions before us.

"While I wholeheartedly congratulate the General Assembly on the passing of this resolution, I would be less than frank if I did not say that some of the speeches which have been made on this and related subjects do not merit the same opinion. In certain respects we seem to be developing a tendency to disregard the substance of problems and to consider them merely as incidents in a continuing polemic. Whatever may be said of less pressing problems, atomic energy is too serious to be treated as an incidental phase in the battle of propaganda. This is one problem before which all mankind stands equally interested and equally defenseless.

"If the horrors of atomic war should ever be visited upon this planet, the pitiful survivors of blasted and ruined cities will take little consolation in the thought that the representatives at the U.N. made brilliant and witty speeches about atomic energy. They will ask just one question: why did you not stop this before it happened?

"If I may presume to interpret the resolution which you have just adopted, it can be summed up in one sentence: Save humanity while there is still time."

After the Assembly concluded action on the atomic issue, Romulo released replies to his four-point suggestion circulated privately to the Sponsoring Powers November 3, 1949.[3] The general tone of these replies was that the Sponsoring Powers appreciated his interest and would consider his proposals.

The Russians lost two other bouts over atomic energy.

Assembly Votes on "Peace Plans"

The General Assembly on December 1, 1949, approved a statement of the Essentials of Peace offered by the United States and Britain as a counter-proposal to the so-called "Peace Plan" put up by Vishinsky as his big idea for this session.

The vote for the Essentials of Peace was 53 to 5 (slav bloc), with Yugoslavia abstaining.

The Assembly rejected by a large "no" the Soviet proposal, which blamed the U. S. and Britain for preparations for a new war and then called for a peace pact among the British, Americans, Chinese, Russians, and French. Some delegates said privately that the Soviet proposal reminded them of a man kicking another man around and at the same time saying "let's make up and be friends." The Russian resolution also had a paragraph calling for adoption of the basic Russian proposals on atomic energy—and this was defeated by a wide margin.

Assembly Asks Armaments Accounting

The last bout on atomic energy took place December 5, 1949, when the Assembly approved a resolution proposed by France and Norway "for the submission by member states of full information on their conventional armaments and armed forces and the verification thereof." The vote for this was 44 in favor, 5 (slav bloc) against, and 5 abstentions. A Soviet attempt to call for information on atomic weapons as well as conventional armaments was defeated by 6 votes in favor (the slav bloc plus Egypt), 39 against, and 9 abstentions.

The approved resolution follows:

"*The General Assembly,*

RECALLING its resolution 192 (III) of 19 November, 1948, and in particular its recomendation that the Commission for Conventional Armaments, in carrying out its plan of work, devote its first attention to the formulation of proposals for the receipt, checking, and publication, by an international organ of control within the framework of the Security Council, of full information to be supplied by Member States with regard to their effectives and their conventional armaments;

"HAVING EXAMINED the records of the discussions in the Security Council and in the Commission for Conventional Armaments regarding the implementation of the above-mentioned recommendation;

"1. APPROVES the proposals formulated by the Commission for Conventional Armaments for the submission by Member States of full information on their conventional armaments and armed forces and the verification thereof, as constituting the necessary basis for the implementation of the above-mentioned recommendation;

"2. CONSIDERS that the early submission of this information would constitute an essential step toward a substantial reduction of conventional armaments and armed forces and that, on the other hand, no agreement is likely to be reached on this matter so long as each State lacks exact and authenticated information concerning the conventional armaments and armed forces of other States;

"3. NOTES that unanimity among the permanent members of the Security Council, which is essential for the implementation of the above-mentioned proposals, has not yet been achieved;

"4. RECOMMENDS therefore that the Security Council, despite the lack of unanimity among its permanent members on this essential feature of its work, continue its study of the regulation and reduction of conventional armaments and armed forces through the agency of the Commission for Conventional Armaments in accordance with its plan of work, in order to make such progress as may be possible;

"5. CALLS UPON all members of the Security Council to cooperate to this end."

That ended the atomic battle in the General Assembly for the Fourth session. General Romulo will carry on his self-appointed assignment of trying to push an atomic agreement even after the Assembly ends. He has strong ideas on the subject, and he will be U.N. Assembly President until another man is elected at the 1950 session. The Sponsoring Powers will hold more conversations behind closed doors during the winter; the first of these meetings is scheduled for December 20.

[3] Printed in the *Bulletin*, V (December, 1949), 345.

THE CONQUEST OF THE UNITED STATES BY GERMANY

Hans J. Morgenthau

Hans J. Morgenthau is Professor of Political Science at the University of Chicago and the author of "Scientific Man Versus Power Politics" and "Politics Among Nations."

AT the conclusion of the Spanish-American War in 1898, William Graham Sumner published in the *Yale Law Journal* an article under the title "The Conquest of the United States by Spain." Its thesis is that "We have beaten Spain in a military conflict, but we are submitting to be conquered by her on the field of ideas and policies."[1] For one who has studied and in part witnessed the policies which have led Germany to the catastrophe of two total defeats within a quarter of a century, the similarities between the intellectual processes underlying these German policies and those which influence much of American foreign policy today, are indeed as striking as they are disquieting. We have beaten Germany in a military conflict, but we are submitting to be conquered by her on the field of ideas and policies.

From the dismissal of Bismarck in 1890 to Hitler, the foreign policy of Germany was guided by three fatal propensities: a lack of a sense of proportion in assessing her own strength in comparison with the strength of other nations, an emphasis upon material force to the neglect of those "imponderables" with which Bismarck never failed to be concerned, an exaggerated and misguided sense of mission which equated power with right. To what extent these three delusions have taken possession of our thinking on foreign affairs is clear for any critical observer to see.

We are here concerned only with the first of these delusions, the depth of which a recent event has made manifest. The authoritative reactions to the announcement that an atomic explosion has occurred in the Soviet Union have demonstrated the extreme extent to which we have lost our sense of proportion and to which we insist that, regardless of what happens, we are naturally superior to all nations, the Russians included.

AMERICAN REACTION TO THE NEWS OF THE SOVIET EXPLOSION

A historian, a thousand years hence, writing the story of American foreign policy from 1945 to 1949 on the basis of the contemporary reactions only, without in any way bringing his own judgment into play, would arrive at strange conclusions indeed. The most important event of that period, touching the national concerns of the United States at their most sensitive, and bringing the world to the verge of war, would appear to him to be the Communist seizure of Czechoslovakia. If he were to use his own judgment, he would not fail to note that this event, while accentuating Russian expansionist tendencies, stabilized the predominance of the Soviet Union over Czechoslovakia which had existed since the end of the Second World War and that it did not infringe upon the line of demarcation between East and West which the United States was resolved to defend. The Communist seizure of Czechoslovakia, then, would appear not as an attack on the existing status quo, to the defense of which the United States was committed, but rather as an accentuation of the existing status quo, an event within the pre-existing Russian sphere of influence which left the actual distribution of power intact and could not be interpreted as a threat to the security of the United States.

Our fictitious historian would find that the United States ranked the trial of Cardinal Mindszenty next in importance for her national interest, while his own judgment would have advised him that, whatever the moral significance of this trial and its importance for the Vatican State, it had no bearing upon the national interest of the United States. The event attracting his attention next would be the Berlin blockade, and he would agree with public opinion that here was an issue which actually affected the distribution of power between the United States and the Soviet Union. Farther down the line our historian would have noticed the shooting-down of American airmen by Yugoslavia, the Greek Civil War, Iran, China, Palestine, and so forth. Far down toward the bottom of the list, he would have detected a little item of obviously minor importance, expected, discounted, prepared for by everybody concerned—the fact that an atomic explosion had occurred in the Soviet Union. How did our political and military leaders comment on this event?

COMMENT BY POLITICAL LEADERS

In his announcement, which in its sombre solemnity seems to emphasize the importance of the event, President Truman declared: "Ever since atomic energy was first realized by man, the eventual development of this new force by other nations was to be expected. This probability has always been taken into account by us."

It was this point which Secretary of State Acheson elaborated in his statement at a news conference of the same day. "I want to emphasize the four basic matters which were brought out in the President's release this morning. Those are: the President has stated the fact that there has been an

[1] William Graham Sumner, *War and Other Essays* (New Haven: Yale University Press, 1911), p. 297.

atomic explosion in the Soviet Union. In the second place, the President has stated that we have been fully aware that sooner or later this development would occur and that in our thinking it has been taken into account. That is an important fact to remember. In the third place, the President has recalled what so many people have forgotten, that in every statement made by him and by the two Prime Ministers as well as by all the commissions and bodies which have studied this matter, it has always been clearly pointed out that this situation would develop. And finally, the President has stated that this event makes no change in our policy."

According to the *New York Times*, "Throughout the question-and-answer session Mr. Acheson took pains to make the point that the news from the White House was no surprise to anyone. All discussions had been conducted on the assumption that other countries would some day begin to catch up to the atomic information of the United States." Mr. Hanson Baldwin stated that "Secretary of Defense Johnson refused, at first, to credit the evidence presented, and apparently still does not believe that an 'atomic explosion' necessarily means an atomic bomb."

The *New York Times* reported as the reaction of "some of the most responsible members of Congress . . . that the American people could have confidence, in any possible crisis, in the military leadership and the military power of this country." Senator Scott Lucas, in particular, did not think "that the Soviet achievement changes the fundamental pattern of world power. The United States still has a four-year lead. . . . Our scientists and our technologists will enable us to maintain our lead. I feel sure that plans and preparations have been made by our Government for any contingency that might arise. I have the utmost confidence in the wisdom of our Secretary of Defense and our military leaders."

COMMENT BY MILITARY LEADERS

As concerns the reactions of "high civilian and military officials," the *New York Times* reported that "In no quarter was there any hint of dismay." General Bradley stated: "We have anticipated it for four years, and it calls for no change in our basic defense plans."

According to the *New York Times*, a certain official suggested "that Russia might have been getting to the point of testing a bomb that might be neither so practicable nor so effective as that [of] the United States. There was also some doubt that Russia had been able to begin stockpiling numbers of the so-called absolute weapon as the United States has been doing since the explosion over Hiroshima. . . . Guarded, carefully considered views expressed privately by high, responsible officials in the Administration were to the effect that the development increased the insecurity of the United States 'by a very small degree.' . . . A military interpretation was that the explosion did not indicate a major improvement in Russian military potential. In support of this view, it was said that one experimental explosion did not mean that Russia had achieved mass production of the bomb. Also, while the United States has had a four-year headstart in atomic bomb stockpiling, Russia will be hindered by her inferiority in know-how, raw materials, engineering facilities and electric power."

The next day the *New York Times* reported "informed quarters" as saying that "This country's policy . . . is being carried forward on the assumption that Russia, as always expected, possesses the bomb although she doubtless is still far behind the United States in stockpiles and production techniques."

General Eisenhower declared: "I see no reason why a development that was anticipated years ago should cause any revolutionary change in our thinking or in our actions."

General Groves commented that "he would not 'lose any sleep over' the announcement, because this country was 'certainly in the lead' in any atomic race. . . . The question was not whether Russia had built an atomic bomb 'but how good that one is, and how many they have, and can they catch up with us?' . . . General Groves said he did not know whether the Russians had an atomic bomb 'because I have never been in Russia—no one knows what goes on in Russia."

General Bedell Smith voiced the belief "that it will take Soviet Russia at least ten years to get to the point of mass production that we have now reached."

Mr. Lilienthal "authorized the UP to represent him as feeling now precisely as he felt before he knew Russia had the bomb," and that "this country must do everything necessary to 'establish atomic leadership.'"

COMMENT BY THE PRESS

Two experts of the *New York Times*, Mrs. McCormick and Mr. Krock, who obtain much of their inspiration from Washington, gave an impressive summary of the official reaction. "There is no reason," says Mrs. McCormick, "why the world should be taken by surprise by the President's statement. What was bound to happen sometime happened a little ahead of schedule but not unexpectedly to scientists, soldiers, or even mere observers of the harrying pace of history." And Mrs. McCormick quotes "experts" to the effect "that in the experiment the Russians destroyed the only bomb they had and probably most of the plutonium in their possession."

The "sharp impact," writes Mr. Krock, "was quickly supplanted by the philosophical reflection, 'eventually, why not now?' . . . The blend of hope in this practical acceptance of what the whole government assumed as inevitable apparently has its source in *a*) the lack of proof that what exploded was an 'atomic weapon' and *b*) in the old military theory of the balance of power."

The *Economist*, on October 8, summed up the official reaction by stating: "There has been, indeed, no glimmering of a new or original thought since the news broke; everyone is just as he was before—only more so."

WHAT THE SOVIET EXPLOSION HAS REVEALED

This curtain of complacency, flimsy, worn, and full of holes, cannot conceal, and by contrast rather puts into stark relief, the three glaring facts with which the atomic explosion on Russian soil confronts the American people: (1) the national obsession to underrate Russian strength; (2) a decisive change in the world balance of power, and (3) the shattering of the foundations upon which American foreign policy has been built.

NATIONAL PROPENSITY TO UNDERRATE RUSSIAN STRENGTH

Nations have a natural propensity to underrate their enemies and to overrate themselves. These distortions are the weeds in the garden of patriotism and of national pride. They may be harmful, but not seriously so as long as a critical intelligence is aware of their existence and applies the corrective of objective analysis to the excesses of self-glorification and of contempt for the enemy. They become fatal, however, if reason refuses to adjust its preconceptions to reality, but persists in them in the face of contradicting facts and endeavors to adjust the facts to the false mental picture which wishful thinking has created.

Well known to psychiatric literature is the case of the neurotic who is unable to apply the test of reality to his mental picture of the world and is under the compulsion to make the latter the standard of reality. After a number of violent clashes between his conception of the world and the actual world, which have the quality of what is popularly called "hysteria," the patient calms down, retires into himself, seems to be confident, self-reliant, and at peace with the world and himself—in one word, "normal" in the popular sense. The truth is that he has succeeded in withdrawing completely from reality as it actually is, substituting for it the reality of his delusion. Now he can rest content, for his diseased mind, having created a world all its own, has made it impossible that his picture of the world and the world itself be ever at odds again. Yet whenever the neurotic must act in relation to the real world he fails, and his failure is the more complete in the measure in which he succeeds in substituting the reality of his delusion for the actual world. Frequently, helpless in infantile contentment, he ends his days in an asylum.[2]

There is a frightening parallel between the typical neurotic reaction to a reality unpleasant and full of problems and the official reaction to the atomic explosion in Russia as it has been recorded above deliberately in tedious detail. Our leaders formed a certain conception of reality in terms of the Russian ability to achieve an atomic explosion within a certain period of time. Even the most conservative official estimates expected an atomic explosion in the Soviet Union not earlier than 1952 and, hence, were off the mark, if we date them at about the middle of 1945, by about 40 per cent.

To cite only one example among many: Mr. Byrnes, on the advice of such authorities as Presidents Compton and Conant and Dr. Vannevar Bush, concluded in June, 1945, that "any other government would need from seven to ten years, at least, to produce a bomb." Writing from the perspective of 1947, he added: "And I think that to accomplish the task at such speed would require a quicker return to normal conditions than has taken place in any other country within the last few years."[3]

[2]Cf., e.g., the case report of A. A. Brill in the Introduction to *The Basic Writings of Sigmund Freud* (New York: The Modern Library, 1938), p. 21*ff*.

[3]James F. Byrnes, *Speaking Frankly* (New York and London: Harper and Bros., 1947), p. 261.

This error is only one in a series which started almost with the Bolshevist regime itself. The Western world has insisted upon underestimating the strength of the Soviet Union, especially in its technological-military aspects, and has done so invariably to its own detriment. The allied intervention in the civil war was based on the assumption that the weakness of the Bolshevist regime would make such intervention successful. During the twenties, a number of otherwise competent observers proved that Bolshevism could not succeed and that its disappearance was a matter of months or of a few years at worst. During the thirties, the Soviet Union figured in the calculations of the Western Powers as a negligible quantity not to be taken seriously as a military factor. It was this argument which was generally invoked with success in the debates on the implementation of the Franco-Russian Alliance of 1935, the Russian offer of support to Czechoslovakia in 1938, and the Anglo-French mission to Moscow in 1939. When Germany attacked the Soviet Union in 1941, the best military opinion in the West gave the Soviet Union from six weeks to six months. And when she survived, it was only logical to attribute her survival either to the climate or to her wide open spaces or, and preferably, to American lend-lease, but not to her own strength.

GENERAL GUILLAUME'S ESTIMATE OF RUSSIAN STRENGTH

How wrong all this is, is clearly demonstrated in a recent book which bears a triple mark of respectability.[4] It is written by General Guillaume, divisional commander in the Second World War and from 1946-48 French Military Attaché in Moscow. It has a Foreword by General Bedell Smith voicing the conviction "that General Guillaume's reasoning and conclusions are sound and that they merit the most careful attention." It is published by the Infantry Journal Press.

For the purposes of our discussion the importance of this book is twofold. First of all, it gives an impressive account of the Russian technological achievements. Let us hear what General Guillaume has to say about the relocation of Russian industries during the war. "The transplanted establishments resumed their activities after a short period for installation. For example, tank factory No. 183 of Kharkov, evacuated in October 1941 to the region of Sverdlovsk, furnished its first tank from the new location on December 18 and reached its prewar level of production by March, 1942. . . . Whenever it could be done, the factories themselves were moved: 75 per cent of the industrial equipment of Leningrad and the numerous factories from Moscow were transferred in this way; and the same was true of the great Putilov factories of Leningrad and the tractor plants of Stalingrad and Kharkov."[5]

General Guillaume gives the main credit for the victory in the East to the Soviet Union. "Nor was it Allied matériel that stopped the Germans at Leningrad, Moscow, and Stalingrad. By 1943, when the Lend-Lease matériel and tools were first flowing in quantity into the USSR, the German armies had already long been arrested or turned back on the entire front from the Black Sea to the Arctic Ocean. Like the Russian winter, the Allied matériel could only hasten the hour of victory."[6]

The Russian industrial effort was the integral part of an over-all war plan and was able quantitatively and qualitatively to hold its own against German production and even to surpass it in certain respects, such as artillery, tanks, and planes. That the over-all industrial productivity and technology of the Soviet Union is inferior to that of the United States is too obvious to need emphasis. The question is, however, whether such over-all comparison meets the point. Over-all inferiority might well be compatible with partial equality, if not superiority in particular sectors upon which the whole national effort is concentrated under totalitarian direction. That such might be the case in the Soviet Union is at the very least made plausible by the evidence adduced in General Guillaume's book.

This book shows also to what extent the errors which proved to be Hitler's undoing were but the errors in which the Western world has persisted to this day. As General Guillaume puts it: "To sum up: Hitler was defeated on the Eastern Front because he never realized the true import of the deep transformation that had occurred in the USSR in every field of endeavor from 1917 on."[7] Underestimation of the Russians is the invariable source of Hitler's misjudgments. "His underestimation of the enemy strength all the way through" says General Heusinger, his chief of operations until July, 1944, "led constantly

[4]Augustin Guillaume, *Soviet Arms and Soviet Power. The Secrets of Russia's Might* (Washington: Infantry Journal Press, 1949).

[5]*Ibid.*, p. 78-79.

[6]*Ibid.*, p. 178.

[7]*Ibid.*, p. 68.

to false deductions and to errors."[8] This holds true of the West at large.

It is against this background of consistent underestimation that one must consider the official reaction to the atomic explosion in the Soviet Union. It would have been a rational reaction to admit that an error had been committed, to search for the causes of that error, and to resolve not to commit a similar error again by changing the attitude from which it had arisen. Nothing of the kind, however, happened. Even those who admit that there was error refuse to admit that the error was of any consequence. After all, what difference does it make if what was bound to happen happens a few years earlier than expected? It makes all the difference in the world, as shall be shown in the course of our discussion. But, then, the plans which have been made in view of that eventuality will simply be put into operation now instead of later. What those plans might be is, of course, a military secret. Yet it is no military secret that the only present defense against atomic bombs is the dispersion and the moving underground of cities and industrial installations, and nothing of the kind is being done.

But is it not true that, if we just keep at it, we will always have more and better atomic bombs than the Russians? Even if this were axiomatic, it would be irrelevant. As I pointed out two years ago in a discussion of atomic disarmament: "The preponderance of the United States in atomic weapons is bound to be temporary. In the not too distant future the Soviet Union will certainly have atomic weapons. If the ratio of X:O is not transformed now into O:O, it will inevitably be transformed later into X:Y. Yet, concerning atomic weapons, X=Y. In other words, once the Soviet Union has atomic weapons, it matters little that the United States will have more atomic weapons than the Soviet Union. It requires only a limited number of atomic bombs to destroy the military potential of the United States. This destruction will deprive the United States of the ability to win a war against the Soviet Union, however much damage it might be able to do by dropping a superior number of atomic bombs on Russian territory."[9]

But, perhaps, what exploded in the Soviet Union was not an atomic bomb at all, or the only one the Russians have, consuming the bulk of their fissionable material. And, probably, it was not a particularly good bomb. Anyhow, we have nothing to worry about, let us have confidence in our leaders and forget the whole thing. Here the neurotic mind has succeeded in withdrawing almost completely from reality and in creating a world of its own in which it feels secure. Yet the collective neurosis of a nation does not end in the infantile contentment of the asylum, but in the terror and misery of a national catastrophe, the ineluctable reward of policies based upon delusions instead of facts.

CHANGE IN WORLD BALANCE OF POWER

The truth is that the acquisition by Russia of an atomic weapon is an event of the greatest importance. In comparison with it, all the great issues of the post-war period fade into insignificance. Certainly in the short-run, and probably for the foreseeable future as well, it overshadows even the passing of China into the Soviet camp.

Its importance lies in the decisive change in the world balance of power which it entails. Upon the recognition of that importance American atomic policy has been predicated from the beginning, as it will become obvious from a general consideration of the factors which determine the balance of power between the United States and the Soviet Union.

However misguided the policy of secrecy with regard to the atomic bomb has been in other respects, it made sense only under the assumption that the monopoly of the atomic bomb was so invaluable an asset of American power that extreme measures and sacrifices were justified to prevent other nations from gaining the knowledge which only the United States was supposed to possess. It was in the exclusiveness of that possession that the American advantage was assumed to reside.

If this assumption was correct—as we think it was—then, obviously, the ability of another nation to make atomic bombs is bound to destroy that advantage. Those public officials who have been insisting upon secrecy because of the inestimable value of the atomic monopoly for American power and now pretend to think nothing of its passing, cannot have been right both times. Either they were wrong when they put so high a price upon the atomic monopoly, or they are wrong now when they declare that the atomic bomb in Russian hands hardly impairs the power of the United States. We think indeed that they are clearly wrong now.

There are eight basic factors which determine the power of a nation: geography, natural resources, industrial capacity, military preparedness, population, national character, national morale, and quality of diplomacy. Making due allowance for the necessarily hazardous nature of any such comparative assessment,[10] we venture to suggest that there are rational grounds for believing that the United States has at present an advantage in three factors: industrial capacity, national character, and diplomacy; that the Soviet Union has an advantage in three: geography, population, and military preparedness; that with regard to one, natural resources, both countries are in a roughly similar position; and that one, national morale, is beyond rational calculation, for there is no way of telling in advance how a people will stand up under the conditions of modern warfare.

We have already referred to the over-all superiority of the United States over the Soviet Union in the field of industrial capacity, a superiority which, however, is not the necessary equivalent of superiority in the production of the implements of war.

We would assume that a people whose national character is marked by self-reliance, individual initiative, spontaneous manipulation of social change, and mistrust of government dictation, possess greater intellectual and moral reserves and a greater adaptability to changing circumstances than a people who have for the whole of their history lived under authoritarian, if not totalitarian rule.

We would also assume that a diplomacy which is uncertain of its goals and methods but operates with the method of persuasion and respects the national independence of other nations will in the long run be superior to a diplomacy which prevails only where military and police power have already decided the issue in its favor.

The geographic advantage of the Soviet Union over the United States consists in two factors. The extension of territory allows an unmatched defense in depth, and it makes possible an equally unmatched decentralization of population and industrial centers.

Aside from this geographic advantage and from the superiority in numbers of population, it is in military preparedness that the chief element of Russian strength is to be found. While certain important factors bearing upon the military power of a nation escape

[8] *Ibid.*, p. 147.

[9] Hans J. Morgenthau, *Politics Among Nations. The Struggle for Power and Peace* (New York: Alfred A. Knopf, 1948), p. 319.

[10] *Ibid.*, p. 109*ff*.

objective determination in advance—such as quality of strategic plans, of leadership, of training, and morale—there are others which are susceptible of such determination. Among them two stand out: the fraction of the national effort spent for military preparedness, and the kind of weapons at the disposal of a nation.

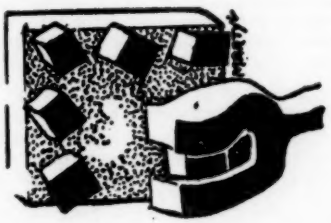
It is obvious that a totalitarian government has a potential advantage in being able to give unified direction to the national effort and direct as much of it as seems desirable and feasible into military channels. The Soviet government has made full use of its power and maintains an army and air force superior in numbers to any other existing army and air force or combination of them. This advantage has in the past been thought to be roughly cancelled out by the absolute American superiority in one weapon: the atomic bomb. It was even generally held that the unique destructiveness of this weapon would give the United States an edge in over-all military strength over the Soviet Union. For while in the initial stages of a war with the Soviet Union the atomic bomb would destroy the latter's industrial centers, the whole American national effort, using a vastly superior industrial potential, would be marshalled for military purposes and would thus overcome the initial Russian advantage in this respect.

The Russian possession of the atomic bomb not only removes the counterweight to the superior Russian military establishment, constituted by the American monopoly of the atomic bomb, it also removes the edge in the balance of power in favor of the United States; for now the superior industrial plant of the United States is as exposed to destruction by atomic bombs as has been the inferior Russian industrial plant.

In sum, in the near future a superior Russian military establishment, supported by an inferior industrial plant and armed with atomic bombs, will confront an inferior American military establishment, supported by a superior industrial plant and armed with atomic bombs. Before the initial phase of the war is over, however, the superior American industrial plant will have been wiped out as well as the inferior Russian one. The atomic bomb is no respecter of technological achievements, and before it all industrial plants are equal. Thus the main potential source of American military superiority will have been eliminated. It is for this reason that we have said that the Russian possession of the atomic bomb constitutes a decisive change in the world balance of power.

DISRUPTION OF AMERICAN TIMETABLE

It remains now to be shown that postwar American foreign policy has been predicated upon the assumption of the military superiority of the United States over the Soviet Union, a superiority which was supposed to last for a number of years but which, as we have seen, is about to disappear, long before its appointed time. In concrete terms, it was assumed that our superiority, derived mainly from the monopoly of the atomic bomb, would come to an end only after we had gained equality with the Soviet Union on land by enabling Western Europe to withstand a Russian attack at least during the period needed to bring American superiority in other fields into play. This assumption underlay the Marshall Plan and the North Atlantic Pact.



The short-term objective of this foreign policy was the containment of Russia, that is, the use of our military superiority for the purpose of maintaining the territorial status quo. Its main expression was the Truman Doctrine. The long-term objective of this foreign policy was the imposition upon the Soviet Union of a settlement which would remove the threat of Russian aggression from Western Europe and would bring to an end the exclusive domination by the Soviet Union of Eastern and part of Central Europe. The strategic moment for obtaining that long-term goal was thought to be the one in which the United States became equal to the Soviet Union on land while retaining its superiority in other respects; that is, after Western Europe had recovered militarily and economically and before the Soviet Union had obtained the atomic bomb.

The acquisition by the Soviet Union of the atomic bomb in 1949 instead of much later has completely upset the timetable upon which American foreign policy was based and has seriously impaired the bargaining position of the United States. It is this relation between the date of the first Russian atomic explosion and the timetable of American foreign policy which makes that explosion so catastrophic an event. It also makes unworthy of serious consideration the official statements that what was bound to happen happened a little earlier than expected, and that is all there is to it. What would we say of a farmer who, surprised by the expected, yet unexpectedly early autumn rains before his harvest was in, resorted to a similar explanation? Or would we find an investor very convincing who, surprised by a break in the market which he expected to occur much later, commented on his bankruptcy as our leaders comment on their failure? In truth, the first atomic explosion on Russian soil has shattered the American foreign policy as it has evolved in recent years. It necessitates the elaboration of a new foreign policy based upon new assumptions to be formulated in the light of a new balance of power. Two such assumptions come immediately to mind.

In view of the unknowns and imponderables which go into the assessment of the respective strength of nations under contemporary conditions, it would be safe to start with the assumption that the United States and the Soviet Union will in the very near future be roughly equal in military strength. The United States has passed the pinnacle of her power in relation to the Soviet Union and cannot hope in the foreseeable future to enjoy again the same freedom of action which was at her disposal in the past. If this is so, the policy of "getting tough" with Russia and the policy of containment have become obsolete. One can afford to get tough with someone and be able to contain him if one is unquestionably superior in strength. But between equals toughness becomes a two-way street, and containment becomes a matter of choice for the one to be contained. In other words, the unilateral application of pressure as the sole means of achieving one's own objectives has become impossible, which is another way of saying that the period of the cold war itself has come to an end. The atomic flash somewhere in Asiatic Russia ended that twilight state between peace and war in which we have been drifting in recent years. From now on, it will be either peace or war.

THE CHOICE BEFORE THE UNITED STATES

It is, then, the other assumption with which a new American foreign policy must start that the alternatives before the United States are either war with the Soviet Union for which we must be prepared, or a negotiated

peace with the Soviet Union for which we must prepare ourselves as well. If we arrive at the conclusion that it is useless to try to negotiate a settlement with the Soviet Union, then we must act on the assumption that war might break out tomorrow—as it well might—and act accordingly. If we believe that the possibilities of negotiating a settlement with the USSR have not been exhausted, then we must ask ourselves four questions: What are our vital interests vis-à-vis the Soviet Union and how can they be safeguarded by mutual agreement? What are the vital interests of the Soviet Union vis-à-vis ourselves, and how can they be safeguarded by mutual agreement? If these vital interests conflict, how can they be reformulated so as to become compatible? How can the issues of secondary importance outstanding between the two nations be settled by compromise?

To repeat: the choice before the United States is to prepare for war or for peace (or, perhaps, for both). We are doing neither, but continue to drift, hypnotizing ourselves into believing that no such choice needs to be made. We do not prepare for war, but reply to the atomic explosion in the Soviet Union with a reduction of the military budget, continue to think that we can do without a general mobilization plan, leave Alaska open to invasion, and find nothing strange in the expectation that the Russians will passively watch us make Western Europe strong enough to defend itself, which under the conditions of modern warfare is tantamount to making it strong enough to attack. We do not prepare for peace, but refuse to face the one issue from which the conflict with the Soviet Union arose and which still dominates it: the question of the domination of Eastern Europe.

The conflict between the United States and the Soviet Union started with incompatible interpretations of the Yalta agreement. Underlying these interpretations was the question, who shall control Eastern Europe—the Soviet Union, the Western world, or both together? This is the decisive question today. Since Eastern Europe can be liberated from Russian domination only by war and since such liberation would certainly not affect the vital interests of the United States in such a way as to be worth a war, the reaffirmation of the political and military essence of the Yalta Agreement by the Western world in exchange for the military and political evacuation of Central Europe by the Soviet Union appears to be the objective toward which a new American foreign policy should aim.

CHURCHILL'S WARNING

In the light of the announcement of September 23, 1949, which adds to its urgency, it is worth recalling the warning which, two years ago, Mr. Churchill uttered in words of profound wisdom:

> I will only venture now to say that there seems to me to be very real danger in going on drifting too long. I believe that the best chance of preventing a war is to bring matters to a head and come to a settlement with the Soviet Government before it is too late. This would imply that the Western democracies, who should, of course, seek unity among themselves at the earliest moment, would take the initiative in asking the Soviet for a settlement.
>
> It is idle to reason or argue with the Communists. It is, however, possible to deal with them on a fair, realistic basis, and, in my experience, they will keep their bargains as long as it is in their interest to do so, which might, in this grave matter, be a long time, once things are settled. . . .
>
> There are very grave dangers—that is all I am going to say today—in letting everything run on and pile up until something happens, and it passes, all of a sudden, out of your control.
>
> With all consideration of the facts, I believe it right to say today that the best chance of avoiding war is, in accord with the other Western democracies to bring matters to a head with the Soviet Government, and, by formal diplomatic processes, with all their privacy and gravity, to arrive at a lasting settlement. There is certainly enough for the interests of all if such a settlement could be reached. Even this method, I must say, however, would not guarantee that war would not come. But I believe it would give the best chance of coming out of it alive."[11]

After his first meeting with Stalin, Mr. Churchill remarked that Stalin left with him "the impression . . . of a complete absence of illusions of any sort." Absence of illusions is indeed one of the marks of the statesman. Politicians, whose horizon is limited by the prospects of the next elections, prefer to delude themselves and their constituents. The official reaction to the atomic explosion in Russia has given us an indication of the depth of our national illusions. That is the German way of making foreign policy, and the fate that awaits such a policy of illusions is likely to be the fate that was Germany's. In such manner politicians may manage to win the next elections. But they also make sure that there remain few elections to be won.

[11] *Parliamentary Debates (Hansard). House of Commons.* Vol. 446, No. 48, pp. 562-63.

The State of Physics; or the Perils of Being Important

(Continued from page 4)

that he could not see the seriousness of this matter. Only a few young men would be involved, to the great good of the majority. This reminded me of an Aztec propitiatory sacrifice at a solar eclipse; only a minute fraction of the population was inconvenienced by having their hearts cut out, and, sure enough, the shadow passed from the sun and the crowds went home rejoicing.

IMPORTANCE OF A PUBLIC EDUCATED IN THE MEANING OF BASIC RESEARCH

University research in physics is being extensively supported from public funds under a program initiated by the Office of Naval Research, and recently made a joint program, with the Atomic Energy Commission participating. This program has had a remarkable success. Many physicists at first looked askance at being sponsored by Navy funds, but soon rejoiced to find that these were allocated with an understanding of the needs and customs of universities and of scientists carrying out basic researches. The strong and politically experienced Navy Department has thus far successfully prevented uninformed politicians from insisting on the introduction of secrecy and guilt-by-association investigations into a region where there is no reason to strangle the geese that laid the plutonium eggs.

But I fear that to many powerful men in Washington the telling argument for the allocation of funds is that physics is important because war is important, and in a war it is well to have a reserve of physicists. It is clear that this argument, as far as it goes, is sound, but if throughout the larger public it should become the foundation of its interest in, and support of, physics, our science would sink to a kind of applied gadgetry unworthy of the inheritors of the tradition of Newton and Planck.

Secrecy is an essential part of that larger evil, war. How long will it be before the poison of secrecy seeps into the ONR–AEC program through political pressure on the AEC? How long will the AEC be permitted to have its own unclassified projects? The most

recent attack of a political opportunist on the AEC was refuted, strictly on party lines. What will happen if the political complexion changes? To look at another facet of the situation, if peace should break out of the cold war, would the support of physics be continued at its present level?

The expenditure of public funds is carefully considered and carefully audited, and rightly so. If we are to obtain public support and at the same time preserve that freedom that universities have won by efforts extending over a thousand years, we must justify these freedoms before the public. We must show that to investigate, to discuss, to criticize, to screen facts from phantoms, to enlarge the boundaries of the human mind, is an activity worthy of public support.

It is not an impossible effort. Consider the great astronomical observatories: Lick, Yerkes, Mt. Wilson, Mt. Palomar. The earlier of these were built at the turn of the last century, and represented expenditures commensurate with those required for a modern physics laboratory. The search for knowledge concerning the stars proves to have a great appeal to the imagination, with no thought for use in war. Of course, in the recent national emergency, astronomers and astro-physicists used their technical training for the war effort as did the physicists.

Surely exploration in that strange, high energy region where the creation of mass from electromagnetic fields is commonplace, and new electrical charges are dredged up from an all-pervading but elusive sea of electricity, is as enthralling as searching the distant galaxies. What could be more fascinating than to re-create short-lived nuclear species which presumably have not existed since their birth and death in the first hours of our epoch, three thousand million years ago?

I believe we should all be more vocal in expressing our approval of the enlightened support we are receiving from the joint ONR-AEC program. We should tell our representatives in Congress of the success of the plan and of our hope that the administrative procedures initiated here will be carried out in a National Science Foundation, if that should be set up in the future. We should, by popular exposition of our subject, let the public enjoy with us its progress and its discoveries. We should justify physics as a worthy intellectual activity of a world at peace.

Essentially as presented at the banquet of the Chicago meeting of the American Physical Society, November, 1949.

SCIENCE, POLITICS, AND CITIZENSHIP

Sir Robert Watson-Watt

Sir Robert Watson-Watt is the eminent British physicist whose wartime researches led to the development of the radar system used by the RAF.

THE whole world is uneasy about the application of scientific knowledge. The politicians, and a majority of ordinary citizens, fear that these applications may go uncontrollably in the direction of further destruction of the bases of our civilization. The scientific workers, and those citizens who have some direct contact with the mind of science, fear that controls and restraints may be continued and intensified to the delaying of applications which could easily and quickly raise the level of our civilization far above any we have yet known.

Fears about the atomic bomb are allowed to obscure hopes for the beneficent utilization of nuclear energy. Scientific workers are being diverted to organizational and improvisational activities in the mitigation of the world food crisis. That crisis would never have arisen had they been given in time encouragement and scope to apply the knowledge already in their possession. It is too late to use that knowledge in the present crisis; its use to avoid future crises will be further delayed by the claims on their time and attention which are made by the present crisis. Far more of the scientific workers than ever before have passed from the stages of dispassionate knowledge of scientific facts to passionate awareness of social needs; the immediate result is, in some cases, a reduction in the value of their unique long-term contributions in favor of non-unique short-term activities.

There is no greater necessity in the world of today than a closer understanding by the politician and the citizen of the motives and methods of science, and by the scientific worker of the inevitability of politics and the responsibilities of citizenship.

The basic scientific motive is a universal curiosity; an insistence on knowing the relations between one fact and another, one event and another; a demand for the painting of a vivid mental picture—whether in mathematical, mechanical, symbolic, or verbal colors—to permit the prediction, from past knowledge, of the consequences of hitherto untried combinations. The basic scientific reward is some elevation, however modest, of the whole stature of the human mind; a mind which for the scientific worker is a universal mind, nationless and ageless.

Inherent in this motivation and in this aim is an implicit or explicit faith in the perfectibility of the universal mind, with which is inseparably associated faith in the perfectibility of the individual mind. The scientific worker may not himself know that he holds this faith; yet his devotion to the extension of scientific knowledge would at best be meaningless and at worst be mischievous but for that faith.

Here is a fundamental contrast between the scientific worker and the extreme classicist. A relatively enlightened British Minister of Education has been heard to say, to an audience comprising many scientific workers, "Our education must essentially rest on the Classics, because they teach us how man has always behaved *and how he will always behave.*" For the holder of such a creed it is not unnatural to believe that there are facts and knowledge that should be concealed, suppressed, or unexplored.

To the holder of the scientific creed there are no bad facts, no evil knowledge. The crimes against science are the failure to establish the facts and the failure to publish or broadcast the knowledge. Other crimes there may be in the applications of science, but those are crimes of the user and not crimes of the provider of knowledge.

Correspondingly, there can be no wrong direction of advance in science. There may be avenues of slow advance, less satisfactory than those of greater speed. There may be sterile spurs and blind alleys, real or apparent. Some such alleys may be blind through the blindness of the explorer, and may open fruitfully after many years before a new explorer with new vision. But even a permanently sterile spur is a solid part of the whole tree of knowledge.

This is a doctrine which is held alike by the most fervent defender of the "Freedom of Science" and by the most vigorous campaigner for the "Planning of Science." Where they diverge is below this lofty plane of quasi-religious devotion to increase of knowledge. It is at the level of selection of subject-matter for research that there enters, consciously or unconsciously, the factor of social awareness.

It is no discredit to either school of scientific worker that they differ fundamentally in their responses. One is prepared to work, patiently and on the whole humbly, adding a single fragment of carving to a cathedral of abstract science, limitless in its final extent and timeless in its calendar of advance towards completeness.

The other cannot look down dispassionately from the pure cold eminence of the eternal verities—no, not of the eternal verities but of successive and imperfect approximations to the eternal verities—on the immediate plight of those who, by the merest of accidents on any scientific scale of estimation, are his contemporaries and immediate followers on this minor planet of a minor sun.

Even the most abstract worker does not, in fact, find himself born with an inevitably foreordained line of activity in science. There is an infinity of scope for scientific advance; he can contribute to it along an infinite variety of routes grouped into a score of major categories. The social atmosphere of his time, the environment of his home, the personality of his teachers, will influence not merely his individual route but the category of route which he follows. He may be conscious or unconscious of the influence; it may be decisive or weak, but it is never absent.

Very rarely is the scientific worker moved by one and one only of the two legitimate driving forces of science, the desire to know and the desire to use. It is extreme to describe one as the motive of science, the other as the motive of engineering in its widest sense. But broadly the distinction is convenient if it is not overstrained. There are few physicists or chemists who are not to some degree *engineers manqués*, few biologists who are not potential physicians and surgeons. And there are few engineering or medical enterprises which do not make some contribution to that stock of "pure" scientific knowledge from which they draw their inspiration and their technique.

These are the ingredients of the scientific mind, the scientific motive and the scientific method which contribute to what is done in "the application of the forces of nature to the use and convenience of man." How are we to attain wisdom and constructive effect in such application?

The remarkably rapid advance in war-time of such scientific and technical devices as radar and the atomic bomb are frequently cited as among the "miracles of science." I believe that the release of energy from the atomic nucleus is in fact the very highest triumph that the human intellect has yet achieved. But the science and the scientific workers are the same in peace and in war. The peak intensity of effort, emotion, and enthusiasm in wresting a new secret from nature is no less than in wresting victory from an enemy.

The difference between the relatively slow advance of nearly basic science and its applications in war and in peace is not inherent in the scientific world but in the political world which determines the facilities put at the disposal of the scientific world. It is fair to say of science and its applications, as of most other things, that humanity gets, on the whole, the world that it desires; it is nearly fair to say that it gets the world which it deserves.

Science does not claim to establish the whole of truth, save on a highly specialized and restricted definition of truth as "truth about the immediately measurable." Science is in itself part, but a part only, of the structure of "the whole truth," which includes the good, the noble, and the beautiful even when these are not quantitatively measurable.

I would ask whether, in fact, the release of the energy, or some little part of the energy, in the atomic nucleus has not been one of the major beneficent contributions of science to political science. For the very first time in the history of the world we have beyond doubt scared ourselves as ordinary citizens into wariness. We have it in our power to destroy ourselves and others with us. We have thought so, in a casual sort of fashion in the past, but now we do not merely know it—we are aware of it; and there is an enormous difference between knowledge and awareness. But the beneficence of that scaring process is not yet as far advanced as I would like to see it.

I do not know why we are discouraged from thinking as nervously, as horrifically, about other means of mass destruction as we are encouraged to think about some of the applications of nuclear energy. I am convinced that the atomic bomb as we see it now, and as we can visualize it in the middle future, is a poor weapon when compared with some of these perfectly terrifying methods of biological warfare of which some of us know by remote hearsay, but about which none of us appear to be sufficiently courageous to talk freely and in an enlightened way as we do about the atomic bomb. At least the atomic bomb has shaken the last relics of political complacency; it may even have opened our eyes to the fact that the atomic bomb alone is not the greatest menace to an unwise world.

It is a platitude to say that the safeguards on the application of science lie in the mind of man, but a platitude becomes a platitude because it is true; it merits no less attention because it is obviously true. The mind of the scientific worker and the mind of political man—that is, of every man—alike require modification, and the modification of minds is what we call education.

We require re-education; political man requires enhancements of his scientific consciousness; scientific man requires enhancements of his social conscience. Each is entitled to reject the claims and assertions of the other—but only if he understands them, not in detail, but in essence and broad content. The "humanist" must know more of that branch of the humanities which is science; the "scientist" must know more of the other esthetic humanities, which are literature and its sister arts, and more of the factual humanities which are history. We cannot attain quick results; we have started late; we must begin by re-educating our educators, but we must begin.

Meanwhile we take comfort from the thought that just as the black-versus-white distinction between "pure" and "applied" science is not found to exist in its extreme form in any save a minute minority of scientific minds, so is the black-versus-white distinction between "scientific man" and "political man"—and for the same reasons—a crude criterion of orienting value only in a world which is in fact painted in all shades of grey, enriched and enlivened by more vivid and more endearing colors.

The world of today, despite its present troubles, enjoys a far higher standard of material comfort and intellectual freedom than ever before. The scientific worker has been essential to the attainment of that standard; he has far more to offer. What we need is mutual understanding, and he seeks that understanding within the limits of two high principles which he cannot abandon. He knows no limit to the perfectibility of the human mind; he will work on no other assumption. He knows no limit to the value of measured truth; he will not believe that the suppression of measured truth can do material good to the suppressor which is not completely outweighed by the harm, moral and material, which such suppression inflicts on the suppressor.

THE CITY OF WASHINGTON AND AN ATOMIC ATTACK

In April of last year President Truman designated the National Security Resources Board as the agency responsible for civil defense planning. The announcement of the Russian bomb has considerably increased public pressure for the activation of our civilian defense program. The Atomic Energy Commission recently sent the following memorandum to Mr. Steelman, Chairman of the NSRB.

IN SENDING the following report to Mr. John R. Steelman, Chairman of the National Security Resources Board, the Atomic Energy Commission wrote:

"The recent atomic explosion in Russia brings closer the time when decisions must be made on major issues of civilian defense, including the matter of dispersal out from congested urban areas of facilities such as those of Government in Washington.

"The Commission is providing this brief, unclassified summary report to the National Security Resources Board which bears the primary responsibility for civil defense planning, as we have provided and will provide other information pertinent to civil defense that comes from our research and operations.

"We believe that the National Security Council may also be interested in the paper because of its pertinence to the important national policy question of dispersal of facilities from urban centers."

* * *

The effects of the explosion of an atomic bomb in a metropolitan area and the problems in civil defense that ensue differ in both quality and quantity from those of high explosive bombing.

The experience of the bombed cities of England and Germany may be utilized for lessons in fighting fires, rescue of trapped personnel, and large-scale care for the wounded and homeless. Knowledge of the problems which are peculiar to an atomic bomb attack, on the contrary, must come from a study of what occurred at Hiroshima and Nagasaki where the bombs were fused to detonate high in the air. The Japanese estimated that the heights of burst were 550 to 600 meters, that is, approximately 1,800 to 1,970 feet. While there is no assurance that an enemy might not detonate his bomb in water adjacent to a city, on the surface of the ground, or underground—each of which would bring its own unique problems—it is more likely that he would resort to an air burst because the latter would devastate a larger area on the surface of the ground. That is, a bomb equal in power to the Nagasaki bomb, if detonated in air over an American or European city, would crush or otherwise render useless the residences, as an example, over an area of six to eight square miles. It presents not only a radiation hazard but an explosive hazard beyond any block-busters and a fire hazard beyond any incendiaries.

THE EFFECTS OF AN AIR BURST

From such a burst there would be four effects near the surface of the ground:

1. Blast, that is, a wave traveling with approximately the velocity of sound would engulf objects in a high pressure;

2. Wind of considerable velocity would follow the blast as the highly heated air near the point of detonation expanded;

3. Heat traveling with the velocity of light, would strike exposed objects and kindle fires; and

4. Radiation would penetrate the bodies of exposed personnel.

Two additional effects should be mentioned. First, from the detonation of the bomb there would result highly radioactive fission products which would rise with the cloud from the bomb to be scattered harmlessly at great distances by the air. Second, near ground zero—the point on the ground directly beneath the point of burst—the radiation would cause objects to become radioactive but at a level which, to judge by Japanese experience, would be harmless to those who entered the area on rescue missions immediately after the incident.

If an atomic bomb is exploded quite close to the ground, as at Alamogordo there will be a small area of residual radioactivity. If a bomb is exploded in water, such as Test Baker at Bikini, there will be considerable amounts of residual radioactivity, depending upon wind, currents, tides, and the size of the body of water.

The blast and wind, which may be considered together, would crush or render unusable the ordinary loadbearing brick-wall dwellings for a distance of 7,000 or 8,000 feet from ground zero, would severely damage steel mill-type buildings for a distance of 4,000 to 5,000 feet, and would cause substantial structure damage in multistory steel or reinforced concrete buildings up to distances of 2,500 feet.

Accordingly, in an instant the usually dependable telephone, telegraph, electric service, and transportation (both public and private) would cease to exist in the damaged area. Also, because of the numerous broken pipes in houses, water pressure would fall to near nothing.

In addition to the direct fires which would follow the flash heat, there would be many more which would start from broken gas and electric lines and in particular, from combustible material coming into contact with cooking and process fires. Fire-fighting equipment inside the damaged area would probably be crushed by the collapse of the firehouses, and, with water pressure gone, the many fires would speedily merge to destroy the greater part of the crushed area.

While this is happening, what would be the fate of the people? In Japan the number of casualties was enormous because the attacking planes were not heeded and people were caught in the

open or with inadequate cover. Consequently, great numbers were badly burned by the flash, many so severely that they died. As radiation passes through the body in any considerable amount a number of tissues which are necessary for normal health are damaged. At Hiroshima and Nagasaki everyone within one-half mile not protected by earth, steel, or concrete died and the incidence of radiation injury was very high up to approximately one and a quarter miles from ground zero.

With adequate warning *which was heeded* and adequate shelters *which were occupied*, the casualties could be greatly reduced. Furthermore, doctors with ample medical supplies, hospital facilities, and blood banks would save many of those who were injured by blast or burns.

WASHINGTON AS A TARGET

No one can do the enemy's thinking for him and decide what he would select as his aiming point in Washington. In addition to some purely military establishments like the Naval Gun Factory, there are three obvious targets: (1) the Pentagon, (2) the area near the Capitol which includes the Senate and House Office Buildings and the Union Station; and (3) assuming 5,000 feet as the diameter of the circle in which there would be severe damage, the area in which is located the White House, Treasury Department, Executive Office, State Department, Interior Department, Navy Department, Pan American Union, Federal Power Commission, Court of Claims, Brookings Institution, National Advisory Committee for Aeronautics, Inter-American Defense Board, American Council on Education, Carnegie Endowment for International Peace, Red Cross, Federal Works Agency, Veterans Administration, Federal Reserve, Reconstruction Finance Corporation, and Atomic Energy Commission. Aiming accuracy being something less than perfect, it is clear that other sites on the rim of the area would also be endangered.

The 5,000-foot diameter circle has been assumed somewhat arbitrarily. It is known from the experience in Japan that at distances of 2,500 feet from ground zero substantial modern tall buildings would suffer such damage that 10 to 15 per cent of their main columns and beams would require replacement, much of their outer wall shell would be stripped off, and they would lose their partitions and their windows. As the distances to ground zero became less, the damage would become progressively greater.

Because it represents modern construction and because the data are available, the Atomic Energy Commission Building is selected as an object for study. Would it protect its population in an attack? From its plans it is found that the building has the following above its floors:

Cover Above	*Inches of Concrete*
Attic Floor	2½
Third Floor	9½
Second Floor	17½
First Floor	25½
Basement	33½

The maximum thickness mentioned, that is, thirty-two to thirty-four inches, may protect against the radiation hazard from a bomb detonating overhead at a height of 1,800 feet. No one can predict the strength of an enemy's bomb. Furthermore, windows, partitions, and possibly walls would become missiles. There would be approximately 80 per cent casualties and, added to this, an unknown number of radiation deaths. Naturally, less substantial buildings and their inhabitants would suffer much greater damage. The inevitable conclusion is that the building should be abandoned in the event of an impending attack, or well before. The predictions for the AEC building are generally applicable to Government buildings in Washington.

SHELTER SYSTEM INADEQUATE

Metropolitan business districts, in which there are great concentrations of population during working hours, are additional vulnerable areas. Shelters for these populations may be provided in basements and in the interior of lower stories of large buildings if the work is undertaken in time. *However, adequate warnings must be assumed for any shelter to be effective. Hence, dispersal is far preferable.*

It must be regarded as probable that fire will spread from the outside to buildings which have been opened by blast and that, in the absence of fire-fighting, their contents will be destroyed. In consequence, valuable records or microfilm copies should be removed to storage vaults.

The hard fact is that a shelter system, while saving the lives of the persons who take shelter, does not guarantee the resumption of vital functions. For example, in the event of an attack upon the Atomic Energy Commission building, the building would be completely destroyed and, following the attack, those who emerged from the shelter would be quite helpless to carry on the far-flung operations of the atomic energy program.

DISPERSAL THE BEST DEFENSE

The alternative to the shelter system and an alternative which not only saves the lives of key personnel but also permits at the same time a continuance of the vital governmental operating functions is—dispersal. The problems which it presents, physical, financial, and psychological, are obviously tremendous and beyond the scope of this paper and the authority of this agency.

Long-range community planning to place projected hospital, fire-fighting, and other essential emergency services in properly dispersed fashion should be encouraged. Routes available for emergency evacuation should be planned. These may well provide effective fire lanes through areas now highly vulnerable.

The attractiveness of the target vanishes with dispersal of some or all of the above-mentioned agencies. Scattered in the outskirts of the Washington area with distances of perhaps two miles between targets, the agencies would have a fair measure of security because no single one of them would be likely to warrant the expenditure of a bomb. Also, and equally important, persons who live adjacent to the original area would be less in jeopardy because the enemy would seek his target elsewhere.

From the experience at Hiroshima and Nagasaki it is clear that if an attack comes to an unwarned population, the most that can be expected of them will be that the uninjured will rescue those who are trapped or injured before they are reached by fire. Because of the confusion and destruction which will follow a bomb burst, general relief must come from the outside. Washington, if attacked, would look for help—that is, for workers, supplies, and equipment—from its outlying undamaged ring and its suburban areas and from cities as distant as Baltimore, Philadelphia, and Richmond. Relief must be organized with this in view. Supplies, supplementary fire-fighting equipment, and new hospitals must be kept outside vulnerable areas.

Safety will in large measure depend upon adequate warning of an attack, warning which it must be assumed will come from the radar system of the National Military Establishment. Such warning, when combined with shelters for those who must stay in threatened areas, will minimize, or even eliminate, casualties. Less effective measures may result in panic, suffering, and 80,000 deaths as at Hiroshima.

PROGRESS IN AEC REACTOR PROGRAM

THE U. S. Atomic Energy Commission has announced the following actions in its reactor development program:

1. Selection of the Bechtel Corporation of San Francisco, California, by the AEC Idaho Operations Office to perform major construction work on the first reactor to be built at the Commission's new Nuclear Reactor Testing Station near Arco, Idaho. This will be an experimental breeder reactor designed to test the feasibility of transmuting non-fissionable uranium into fissionable plutonium in a process that produces more fissionable material than it consumes. Work on the reactor is beginning immediately, and is expected to be completed by the end of next year.

2. Decision to locate the AEC's proposed materials testing reactor at the Idaho reactor testing station. This will be an experimental reactor designed to provide information on the behavior of materials under severe radiation conditions so that reactors producing large quantities of useful power may ultimately be built. Detailed design work on this reactor has been underway since September, and construction is scheduled to begin by next spring.

3. Scheduling of December 1 as the date for transfer of custody of Naval Proving Ground property near Arco, Idaho, to the AEC from the Navy Department. Construction of roads, power lines, water systems and other facilities is underway. The 173,000-acre Proving Ground will serve as the nucleus of the proposed 400,000-acre Nuclear Reactor Testing Station. Actual ownership of the property will be transferred at a later date.

The status of work on the four reactors currently comprising the Commission's reactor development program is as follows:

EXPERIMENTAL BREEDER REACTOR

The nuclear design of this reactor (mentioned above) has been completed by the Argonne National Laboratory at Chicago, Illinois, and detailed architect-engineering design work is more than 90 per cent complete. The architect-engineer for the reactor structure is the Austin Company of Cleveland, Ohio.

The Bechtel Corporation will build the steel, brick and concrete reactor structure, as well as the control, ventilation, cooling, and other auxiliary equipment. The reactor core—heart of the nuclear machine—will be furnished by the Argonne National Laboratory, where it is being designed and built.

The experimental breeder reactor is designed to test the practical feasibility of breeding with fast neutrons and to investigate the application of liquid metals to the removal of fission-produced heat from reactors at high temperatures. Originally planned for erection at the DuPage County, Illinois, site of the Argonne National Laboratory, the reactor will be built at the remote site so that it may be operated at a higher power level than would be feasible in a populated area. This will increase the usefulness of the reactor as a research tool by making possible greater flexibility in design and operation. Although the reactor is not designed for the purpose of producing useful power, an incidental amount of power may be produced by a by-product.

The breeder reactor will differ from the fast reactor now in operation at Los Alamos in the design of fuel elements and type of coolant used to extract the energy. Furthermore, it will operate at a very much higher power level. Total cost is expected to be about $3,500,000. The work to be performed by the Bechtel Corporation will total $2,500,000.

MATERIALS TESTING REACTOR

The scientific design of this reactor has been developed in a cooperative effort by the Oak Ridge National Laboratory and the Argonne National Laboratory. A $1,870,000 contract for detailed engineering design work on the reactor was signed last September with the Blaw-Knox Construction Company of Pittsburgh, Pennsylvania. Design work is under way, and construction is expected to begin by next spring.

The primary purpose of the materials testing reactor will be to test under conditions of severe neutron bombardment the materials which may be used in future reactor construction. The materials to be tested will be contained in test pockets. The neutron bombardment to which they will be subjected will be of an intensity very much greater than any ever experienced before. Since the power reactors of the future will be operated at greater neutron intensities than those in operation today, it is important to learn in advance how various materials that might be used in the structures, cooling systems, or shields will react under these unusual conditions.

The materials testing reactor is of particular interest in the development of reactors for the propulsion of aircraft, since it points in the direction of compact, high radiation density reactors which must ultimately be developed if aircraft are ever to be propelled by atomic energy. On the basis of rough preliminary estimates, it is expected that the reactor will cost about $25,000,000.

SHIP PROPULSION REACTOR

The Argonne National Laboratory and the Westinghouse Electric Corporation are engaged in the development of a land-based prototype of a reactor suitable for ship propulsion. Although this reactor, like the experimental breeder reactor and the materials testing reactor, will be built at the Nuclear Reactor Testing Station in Idaho, the engineering and development work is being carried out at Argonne and in the new laboratory of the Westinghouse Atomic Power Division on the site of the old Bettis Airport near Pittsburgh. Construction of the new laboratory was begun in July, 1949, and is scheduled for completion by next summer. Present obligations under the Westinghouse contract are approximately $6,000,000, of which about $2,600,000 is for operating costs and $3,400,000 for capital construction costs and equipment.

Research and development work is well advanced, and detailed engineering design of the ship propulsion reactor is scheduled to begin in about a year. Construction should be underway by 1952. Although cost estimates cannot be made until detailed design specifications have been completed, it is expected that the reactor will cost at least $25,000,000, and perhaps substantially more.

The ship propulsion reactor will be a single purpose machine designed specifically for the purpose of produc-

ing large amounts of heat under conditions that will permit conversion to power for propulsion of naval vessels.

INTERMEDIATE POWER BREEDER REACTOR

Engineering design work on this reactor, planned for construction at the West Milton N. Y., site of the Knolls Atomic Power Laboratory near Schenectady, is being carried forward to permit a firm estimate of construction costs to be made. Preliminary site work, now under way, is expected to be completed in time for construction of major facilities to begin as early as possible in the 1950 construction season.

The Knolls reactor is designed to produce significant amounts of electric power utilizing neutrons in the intermediate energy range, and to investigate the possibilities of breeding fissionable material at the same time. If successful in both, this reactor would represent a major step forward in the direction of the production of useful power without depleting—and perhaps even increasing—the national supply of fissionable material. To date, no reactor has been built to operate in the intermediate energy range. Like the experimental breeder reactor, the heat energy of the intermediate reactor will be removed by means of liquid metal. This heat will then be used to generate power through conventional means. The Knolls reactor is expected to have an eventual cost of from $25,000,000 to probably as much as $40,000,000 depending upon the technical problems encountered.

NUCLEAR REACTOR TESTING STATION

Invitations to bid have been issued and in a number of cases construction work has already started on access roads, water lines, excavations, utilities and a pump house at the former Naval Proving Ground site. It is expected that about 300 to 400 construction workers will be employed by the end of this year, and that about 2,000 workers will be on the job by the end of 1950.

In addition to the 173,000 acres of Naval Proving Ground land, the property to be transferred by the Navy to the AEC included shops, storage facilities, and barracks. Virtually all of the existing buildings will be utilized by the AEC. The transfer of the Proving Ground property to the AEC was authorized by the AEC appropriation act for fiscal year 1950, which set aside $2,700,000 for transfer to the Navy for use in acquiring new facilities to replace those at Arco.

A survey to determine the boundaries of the remaining acreage required for the Nuclear Reactor Testing Station is now being carried out with the assistance of the Bureau of Land Management and the U. S. Army Corps of Engineers. All but 20,000 acres of the proposed area is owned by either the Federal Government or the State of Idaho. The AEC selected the Idaho site as the best site for the testing station last March after surveying more than seventy possible locations throughout the United States.

Loyalty Tests Cause Cut In AEC Fellowship Program

THE AEC announced on December 15 that its program of supporting advanced science students will be curtailed because the National Research Council (the organ of the National Academy of Sciences charged with the selection of the fellows) is reluctant to handle this selection if it involves loyalty investigations of applicants for fellowships in non-secret research. The cut will bring the number of AEC fellows from the present 421 down to about 250, in the academic year, 1950–51.

Legislation requiring FBI investigation for all new applicants for AEC fellowships—whether or not they were to have access to secret data—was passed by Congress as a rider to the Appropriation bill authorizing expenditures for the fellowship program. It was the Congressional reaction to the "Freistadt case," in which an avowed Communist was found to be a recipient of an AEC research fellowship.

Under the abbreviated program, no new fellowships for students working for a doctor's degree will be offered. New fellowships for those holding a doctor's degree will be offered only for research in which access to secret data is needed.

The letters exchanged between the AEC general manager, Carroll L. Wilson, and the President of the National Academy of Sciences, A. N. Richards, were not available when this issue went to press. The decision of the AEC undoubtedly will bring to a head (and probably was intended to bring to a head) the drive for the establishment of a National Science Foundation as the proper agency for handling research fellowships in all non-secret fields, including those directly or indirectly related to the atomic energy program.

BOOKS

Constructive Uses of Atomic Energy. Edited by S. C. ROTHMANN. New York: Harper & Brothers, 1949. Pp. 258. $3.00.

This book is an anthology of articles written for various publications, mostly technical journals. Though a good job of selection and editing, it turns out to be a coherent and readable book on the subject. One of the chapters ("The Medical Uses of Atomic Energy," by Dr. C. P. Rhoads) is based on material which appeared in this *Bulletin*, and is a fair sample of the excerpts as a whole. They are accurate, informative, and specialized, but they do not assume technical knowledge.

The book begins with Chancellor Compton's Franklin Medal Lecture, read in November, 1945, entitled "Atomic Energy as a Human Asset." It is of much interest to one who has followed progress (if that is the word) in political thought regarding atomic energy, to be carried back *via* Dr. Compton's article to the days when we were at once lucid and naive and thought in terms of the rather more than less immediate inevitability of international sanity and world government.

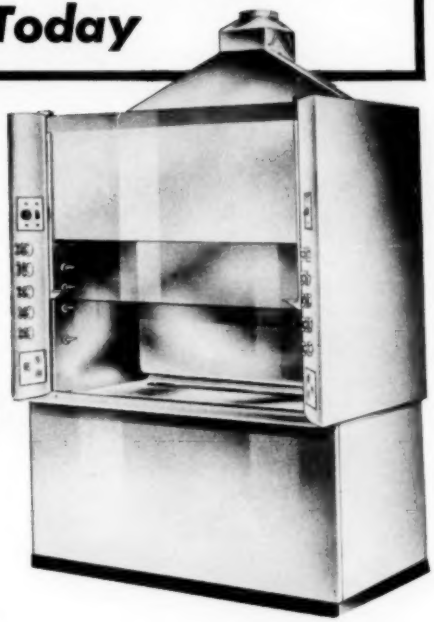
Following a general description of "atomics" by L. W. Chubb, a series of chapters describe various industrial, research, medical and agricultural techniques and possibilities. The glossary of terms is useful but a little spotty, some definitions being encyclopedic and others very brief. There is a bibliography of 323 papers and books, including several familiar to readers of the *Bulletin*.

The book is recommended to lay readers of the *Bulletin* as one of the most satisfactory which has appeared. It also will be found to contain many sections of interest to specialists within the field or to those with a fairly broad knowledge of the subject. This reviewer has found the bibliography of great use as a guide to the popular and semi-popular literature in atomic energy, and the text often stimulating to the overspecialized mind.

—AUSTIN M. BRUES, M.D.
Institute of Radiobiology and Biophysics
University of Chicago

The FUME HOOD of the FUTURE . .
is Yours Today

Kewaunee's New LOW VELOCITY FUME HOOD for Handling RADIO-ACTIVE ISOTOPES



Design Approved for Use by the OAK RIDGE INSTITUTE of NUCLEAR STUDIES

No. 3600—Kewaunee's "FUME HOOD of the FUTURE"

The Hood is made with stainless steel interiors and ducts throughout and incorporates a stainless steel working surface and trough. The working surface will support a load of 4,000 pounds. The Hood incorporates a new system of airfoils, baffles and ducts which provides a uniform flow of air over the entire face of the Hood, thus assuring evacuation of gases at extremely low velocities without interference from reverse eddies or turbulence. No auxiliary duplicate duct system for incoming air is required.

Write for Descriptive Literature and Drawings available now on Kewaunee No. 3600—"The Fume Hood of the Future"

Kewaunee Mfg. Co.
C. G. Campbell, *President*
5088 S. Center Street Adrian, Michigan
Representatives in Principal Cities

Just How Important Is

THE ATOMIC BOMB?

IN these times of mounting tensions, the atomic scientists continue—as they have since the bomb fell on Hiroshima—to tell all who will listen of the social and political implications of their discoveries. Their message is increasingly important: "The responsibility to see that atomic energy is used for the benefit and not the destruction of mankind is ours—and YOURS."

THE scientists do not claim to have all the answers but they are continually exploring the relationship between science and society, between the potentialities of atomic warfare and the survival of civilization. The monthly BULLETIN OF THE ATOMIC SCIENTISTS is their medium for keeping abreast of developments in this field. It should be yours, too, if you are to participate intelligently in the democratic decisions on which our destiny may hinge.

JUST how important is the atomic bomb? The term "atomic age" seems to have drifted into our vocabulary. Its implications are too often absent from our thinking. Recent issues of the BULLETIN OF THE ATOMIC SCIENTISTS show how the problems created by atomic energy impinge on every phase of our existence.

WARFARE. In an authoritative article, "How Dangerous Are Atomic Weapons?", Edward Teller discussed the probabilities of newer, more powerful bombs, capable of producing a radioactive cloud that could endanger a continent. Austin Brues' report of his observations with the Atomic Bomb Casualty Commission described the effects of atomic bomb injuries and revealed a previously untold story of the Japanese decision to surrender. "Atomic Bomb Explosions—Effects on an American City" by R. E. Lapp outlined the probable effects of an atomic attack on a city and examined some aspects of atomic defense.

POLITICS. A workable system for the prevention of warfare and the control of atomic energy is the only answer to the political problem posed by the atomic bomb. The BULLETIN has carried articles by Quincy Wright, Warren R. Austin, Leo Szilard, Abba P. Lerner, Edward A. Shils, Cuthbert Daniel and Arthur M. Squires, Harold C. Urey, Philip Morrison and Robert R. Wilson, David E. Lilienthal, J. Robert Oppenheimer, and others, all dealing with phases of this problem. In addition, the BULLETIN carries a monthly review of United Nations developments in the field of atomic energy, regular reports on the events in Washington, including extensive excerpts from Congressional proceedings. The BULLETIN also carries reports on atomic energy developments abroad by leading scientists in national atomic energy establishments. The BULLETIN has printed the texts or careful condensations of major documents issued by the UN and the United States Atomic Energy Commission.

ECONOMICS. BULLETIN readers are kept informed on economic aspects of atomic energy by articles such as the authoritative report on the costs of atomic power and the economic factors which may affect its use by Sam H. Schurr, co-director of the study of Economic Aspects of Atomic Energy conducted by the Cowles Commission at the University of Chicago.

SCIENCE. Although the BULLETIN is not a technical journal, its articles on the developments in science which importantly affect our civilization have attracted wide interest and comment. Articles by H. J. Muller, Lee DuBridge, Edward Teller, J. Robert Oppenheimer, and others have covered the field from the effects of radiation on the genes and heredity, to proposals for reorganization of research.

All these articles, and many more, dealt with problems of vital concern to you. If you missed them, you owe it to yourself as an intelligent citizen, to see that you do not miss future issues, as the BULLETIN continues its coverage of the most important problem the human race has faced since the discovery of fire.

Bulletin of The Atomic Scientists

53 West Jackson Blvd., Chicago 4, Illinois

Please enter my subscription to the BULLETIN for 1 year at $5.00
My check or money order is enclosed.

Name.....

Street Address .....

City ..... Zone..... State.....

☐ Please send me information about special rates for group subscriptions for schools, colleges and educational organizations to be sent to one address.

Subscribe

Today!